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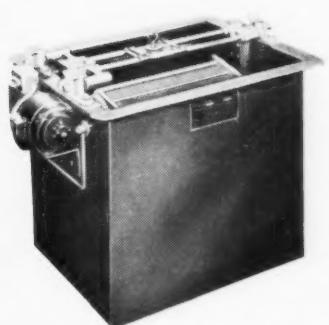
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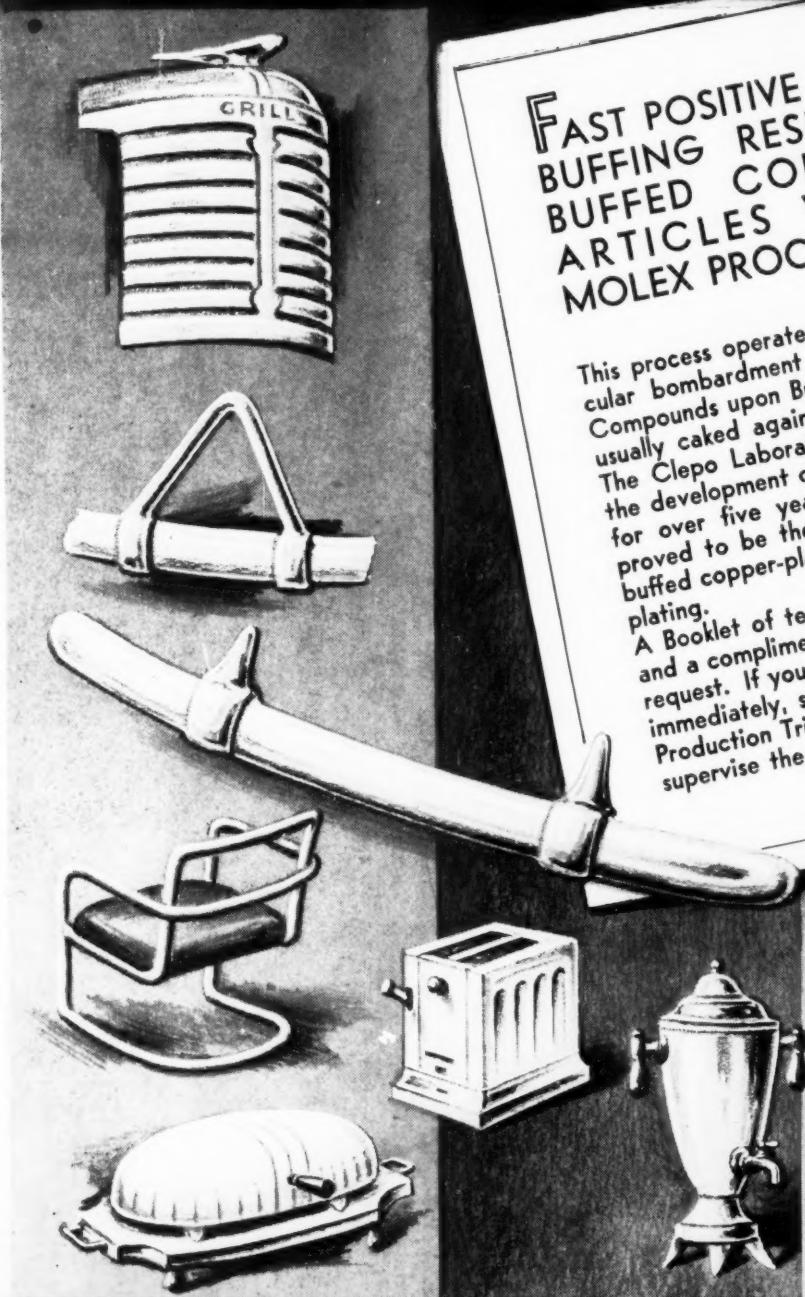
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# METAL FINISHING

PREPARATION, ELECTROPLATING, COATING

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## Convention Next Month

We have all laughed at the one about the fellow who requested of the judge that he be excused from jury duty, not because the business couldn't get along without him but because he didn't want the boss to find out that it could. Every year, as the date approaches for the annual convention of the *American Electroplaters' Society* and platers tell us that they would like to attend but couldn't possibly get away for a week, we wonder how much truth there really is in that old chestnut.

No employer in his right mind could tolerate a situation where functioning of the business was dependent on a single individual in his employ. A good foreman is one who has his department so well organized that it would function perfectly even if he were to be laid up for a few weeks. Such organization is for his own protection since it insures that the job will be available upon his recovery, whereas an indispensable man would have to be replaced immediately. No foreman worthy of his salt should be afraid to take time off to attend a technical gathering. On the contrary, he should consider it an opportunity to show his employer how well his department has been organized.

The employer who doesn't permit his foreman or chemist to attend such meetings is taking a very short-sighted attitude. After all, such employees are not machine operators, whose time away from the machine is lost time. The foreman and chemist think after hours too, for the benefit of their employer. Ideas they pick up during discussions, which are a very important part of any technical meeting or convention, result in more efficient operation of the finishing department and in an increased store of information, which pays dividends when troubles arise, as they will in the best of plants.

No convention was held last year because of travel restrictions, which have since been removed. The coming meeting next month offers an opportunity for metal finishers to bring their technical outlook up to date, to learn about developments which have never appeared in print and to return to their jobs with renewed enthusiasm to put newly acquired ideas to work.



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# The Significance of Water in the Plating Room

By ZACHARY IRENAS

Sup't. of Metal Finishing Dep't., General Instruments Corp., Elizabeth, N. J.

IN THE Bible, the Book of Exodus, chapter 15, Verse 22, we read as follows: "And when they came to Marah, they could not drink of the waters of Marah, for they were bitter. And the people murmured against Moses, saying, 'What shall we drink?'

"And he cried unto the Lord; and the Lord showed him a tree which when he cast into the waters, the waters were made sweet." This is undoubtedly the first water purification in recorded history.

Since water is the most essential requirement of life, it is no wonder that the ancients were concerned about it as much as we are. Although they lacked the necessary engineering materials for the construction of water works in the modern sense of the word, they did build rather elaborate water distributing systems. Some of those built by the Romans are still in existence and are being used to this very day.

Water is undoubtedly the most abundant and most important domestic and industrial material in the world. There is hardly an industry that does not utilize water in some of its processes. Although any school boy will tell you glibly that water is composed of hydrogen and oxygen, the real story of water is not so simple as that. Such widely used terms as hard water, soft water, distilled water, heavy water, sea water, rain water, well water, and city water indicate that the study of water is an extensive one.

Absolutely pure water, namely a chemical compound composed of 83.81% oxygen and 11.19% hydrogen by weight is indeed a rare compound and is used only in exceptionally accurate analytical work. Ordinary distilled water, contrary to popular conception, shows upon analysis that it contains, in solution, traces of many chemical compounds. The extent of impurities in the distilled water is of course dependent on the source of the original water.

All natural waters contain in solution, or in suspension, a host of organic

and inorganic compounds and elements that impart to them various characteristics. In addition, most waters also contain a variety of micro-organisms. The quality and quantity of dissolved or suspended matter is determined by the source of the water. For example, shallow well water differs greatly from deep well water. The latter contains, as a rule, a large quantity of dissolved minerals. To be sure, not all deep well waters, nor all shallow well waters are identical. Their composition is in turn determined by the locality of the well. Often the quality of water from two sources show exceedingly great variations. For example, sea water contains about 19,000 ppm (parts per million) of chlorides, while water from Catskill, N. Y., one of the purest in the United States, has only one ppm.

When a sample of water is submitted for analysis, the quantities of impurities are reported in ppm instead of percentages. This is done for a definite purpose. Let us take an analysis of the water of a mid-western city.

#### Example:

Total dissolved solids	434 ppm
Loss on ignition	17 "
Total dissolved solids	434 ppm
Loss on ignition	17 ppm
Silica $\text{SiO}_2$	10 ppm
Fe present as $\text{Fe}_2\text{O}_3$	109 ppm
Calcium $\text{Ca}^{++}$	92 ppm
Magnesium $\text{Mg}^{++}$	34 ppm
Sodium and potassium	9.6 ppm
Bicarbonate $\text{HCO}_3^-$	339 ppm
Sulphate $\text{SO}_4^{=}$	84 ppm
Chloride $\text{Cl}^-$	9.6 ppm
Hardness as $\text{CaCO}_3$	369 ppm

If the impurities were reported by percentages the report would appear as follows:

	%
Total dissolved solids	.0434
Loss on ignition	.0017
Silica $\text{SiO}_2$	.001
Fe present as $\text{Fe}_2\text{O}_3$	.0109
Calcium $\text{Ca}^{++}$	.0092
Magnesium $\text{Mg}^{++}$	.0034
Sodium and potassium	.00096
Bicarbonate $\text{HCO}_3^-$	.0339
Sulphate $\text{SO}_4^{=}$	.0084
Chloride $\text{Cl}^-$	.00096
Hardness as $\text{CaCO}_3$	.0369

The latter report is rather cumbersome and often misleading. Certain impurities that may eventually cause damage to machinery or to the successful operation of a plating solution may be entirely disregarded since the percentages of many substances are often only one thousandth of one per cent. In other words, a report by percentages may lead one to believe that the water is practically free of any foreign matter and therefore can be ignored.

According to ASTM Designation D 596-41 the following constituents of industrial waters are to be reported in a water analysis:

#### Physical Tests

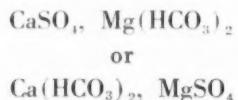
Dissolved solids  
Suspended solids  
Color and odor  
Turbidity

#### Chemical Tests

Dissolved Gases	Oxygen Total carbon dioxide Total ammonia
Miscellaneous	Total hardness Alkalinity and acidity pH Organic matter Silica $\text{Al}_2\text{O}_3$ and $\text{Fe}_2\text{O}_3$ Oily matter extractable by suitable solvents
Metallic ions (cations)	$\text{Ca}^{++}$ , $\text{Mg}^{++}$ , $\text{Na}^+$ , $\text{K}^+$ $\text{Fe}^{++}$ , $\text{Fe}^{+++}$ , $\text{Al}^{+++}$ $\text{Mn}^{++}$ , $\text{Mn}^{++++}$
Non-metallic ions (anions)	$\text{CO}_3^{=}$ , $\text{HCO}_3^-$ $\text{OH}^-$ Orthophosphate, $\text{PO}_4^{=}$ , $\text{HPO}_4^{=}$ , $\text{H}_2\text{PO}_4^-$ Sulphate $\text{SO}_4^{=}$ , $\text{HSO}_4^-$ Chloride $\text{Cl}^-$

In special cases water analysis reports also include the following additional constituents:  $\text{H}_2\text{S}$ ,  $\text{Cl}_2$ ,  $\text{H}_2\text{SO}_3$ ,  $\text{Ba}^{++}$ ,  $\text{Zn}^{++}$ ,  $\text{Cu}^{++}$ ,  $\text{Pb}^{++}$ ,  $\text{SO}_3^{=}$ ,  $\text{S}^-$ , and

$\text{NO}_3^-$ . It is recommended that all dissolved solids be reported in epm (equivalents per million) as well as in ppm. The epm is obtained by dividing the ppm by the equivalent weight of the corresponding item. Since the equivalent weight of one substance reacts with or displaces equivalent weights of any other substance in any chemical reaction, it is obvious that epm's are convenient figures to deal with. It should also be noted that all metallic and non-metallic substances are reported in their ionic form; otherwise two separate reports of the very same water sample may seem different. For example, if a water sample contains calcium, magnesium, bicarbonate, and sulphate in solution, two seemingly different reports may be issued unless the ionic form is used, i. e.:



Many old plating text books, which supposedly reveal trade secrets, often recommend rain water for making up plating solutions. Although the advice is sound, it could hardly be followed in any modern plating shop. Rain water is the purest of all natural waters, although not entirely free of impurities. Since all natural waters contain in solution or suspension many impurities and since all commercial plating baths, alkali cleaners, pickles, and above all rinses, are aqueous, it is to the advantage of metal finishers to acquaint themselves more and more with water, chemically known as hydrogen oxide. A more intimate knowledge of the water substance will lead to a better understanding of metal finishing problems. Since there is water everywhere in the plating room, we do not see the forest for the trees. We are very much concerned with the purity of chemicals used in our plating baths, or with the purity of the metal in our anodes, yet pay little or no attention at all to the widest used substance.

The source of all waters are rain water, surface water (streams, rivers, and lakes), and ground water (wells and springs). Rain water is the purest of them all. Although relatively pure, it contains in solution oxygen, carbon dioxide, and some suspended matter. The latest theory is that each droplet of rain is formed around a dust particle. Even rain water differs from one locality to another. Rain water in an industrial area is more likely to contain

hydrogen sulphide in solution and dirt in suspension. Rain water in an industrial area is generally less pure than rain water in a rural area. The quality of either surface water or rain water is not alike in all localities, in spite of the fact that they are known under one classification. The quality of any water is a function of its locality and physiography of the land it has traversed.

When we examine the water cycle in the universe, the existence of such a wide variety of waters is apparent. All surface waters are constantly evaporating. The water vapor turns into rain or snow, which eventually finds its way back to lakes, rivers and wells. Since the earth is composed of many water soluble mineral substances, all waters either dissolve or carry along with them a variety of materials on their way.

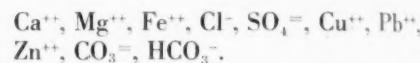
In metal finishing work, as a rule, we either make use of municipal water or water from a private source, such as a well, lake or river. The former is treated prior to distribution. This treatment usually consists of the following steps:

Sedimentation  
Coagulation  
Filtration  
Disinfection  
Demineralization

It is not within the scope of this paper to go into detail of these processes. It is enough to say that their function is to remove suspended and colloidal matter from the water, destroy bacteria, and remove some of the mineral substances dissolved in it. Although municipal water is considered pure and safe, we should bear in mind that purity is an abstract term. We should also bear in mind that the quality of all municipal water vary a great deal. Namely, the residual substances in the water after treatment depends on the original source of the water and on the method of treatment. In addition, the quality of treated water of the same municipality varies somewhat throughout the seasons. Since millions of gallons of water are distributed for municipal supply daily, the water purification plants are under the constant supervision and vigilance of chemists, engineers and health officers. When one makes use of municipal water in the plating room, a complete chemical analysis may be obtained from the chemist in charge. Such a report will serve as a guide in one's metal finish-

ing operations. If, on the other hand, the source of our water is a private one, it should be analyzed by a competent chemist, so that one knows what he is up against.

With the advent of high speed, hot plating solutions, the importance of the purity of water has increased. First, many of the solutions are susceptible to small traces of impurities; and second, the accumulation of dissolved or suspended matter in the bath is much greater with hot solutions, because of frequent water additions to make up for evaporation. Some anions or cations present in water may affect the character of the deposit, the efficiency of metal cleaning solutions, the quality of a burnished finish, and occasionally welded joints of steel tanks. The ions we are mostly concerned with are:



Any water that requires an excessive amount of soap to form lather is termed hard water. Such water contains  $\text{Ca}^{++}$  and  $\text{Mg}^{++}$  and to a lesser extent  $\text{Fe}^{++}$  and  $\text{Al}^{+++}$ . The absence of these ions will render the water soft.  $\text{Ca}^{++}$  and  $\text{Mg}^{++}$  prevent the immediate formation of lather because of the following chemical reaction.



In other words, quantities of soap are consumed before it performs its function. The resultant precipitate is a sticky insoluble substance. The total hardness of water is usually expressed in terms of  $\text{CaCO}_3$  equivalents, because it is the most important constituent of hardness and because its molecular weight may be taken as an even 100. When the total hardness in water is greater than the carbonate and bicarbonate alkalinity, the amount of hardness equivalent to the alkalinity is called carbonate hardness, and the amount of hardness in excess of it is called non-carbonate hardness. According to the U. S. Geological Survey, the hardness of water for either domestic or industrial use can be classified as follows:

Class	Hardness range ppm	Type	
		Soft	Slightly Hard
1.	0 to 55	Soft	Slightly Hard
2.	56 to 100	Slightly Hard	Moderately Hard
3.	101 to 200	Moderately Hard	Very Hard
4.	201 to 500	Very Hard	

Chemical water softening consists essentially in the removal of calcium as calcium carbonate and magnesium as magnesium hydroxide. Although there are many chemicals which remove the calcium and magnesium from water as precipitates, the ones most commonly used are soda ash and lime.

Calcium and magnesium are especially troublesome in burnishing operations, cleaning solutions and hot water rinses. Since soap is the lubricating material in burnishing metal parts, it is evident that the soap will precipitate as a sticky insoluble curd if hard water is used. The calcium and magnesium stearate (if the soap used is sodium stearate) is exceedingly difficult to rinse off and as a result it interferes with the final finish. In addition the calcium and magnesium in the water consume part of the soap and thereby decrease the necessary lubrication. It would be profitable for barrel burnishing operators to understand fully the extent of damage hard water is responsible for in their operations. It is recommended that a stock solution of soft water be kept for burnishing purposes.

Since alkaline cleaners often contain soap as one of their constituents, or soap may be formed therein as a result of saponification, it is again obvious that magnesium and calcium ions in hard water will combine with the fatty acid radical of the soap to form insoluble sticky curds. Therefore, a cleaner should contain not only detergents to clean soil off the work but should also contain water softening substances to take care of the calcium and magnesium in the water. Often complex phosphates are added to a cleaner in order to keep the calcium and magnesium compounds in solution. These substances are called sequestrants.

Hogaboom<sup>1</sup> points out in his article, "Water in the Plating Room," that hard rinse water prior to cyanide plating solutions may result in rough, pitted and porous electrodeposits, because of calcium carbonate precipitating on the surface of the work. He further points out that staining of the electrodeposit may be traced to hard water in the final hot water rinse. In order to eliminate it, it is recommended that the final hot water rinse tank be changed often,

thereby preventing the accumulation and precipitation of calcium and magnesium salts. Duggin,<sup>2</sup> in his article on "The Effects of Water Impurities Upon Nickel Deposits" observes that calcium ions do not affect the character of nickel deposits directly, the precipitate  $\text{CaSO}_4$ , however, is manifested in bright nickel baths by spotted deposits, generally on surfaces in a horizontal plane.

Although copper is rarely present in natural waters, it is sometimes present because of the addition of copper sulphate as an algaecide and because of the increased use of copper and brass pipes in water distribution. Copper is harmful in nickel, cadmium and zinc baths.

Lead is also rarely present in water, yet it may sometimes be found as a contaminant in certain mining districts or because of the use of lead pipes in the distributing system. Lead (0.01 g./L.) causes dark smutty deposits in high speed copper solutions, and as little as 5 mg./L. reduces the throwing power materially in iron plating baths.<sup>3</sup> Lead also causes dark deposits in alkaline tin plating baths.

Nearly all waters contain small amounts of iron. Iron in nickel plating solutions is conducive to pitted deposits.

Chlorine, the most commonly used chemical in the disinfection process prior to water distribution, may at times cause trouble in some plating baths. Promisel & Wood<sup>4</sup> state that the silver plating industry carefully excludes even small concentrations of chloride to prevent attack of steel in contact with the solution, steel anode supports, etc. Chlorine also causes nodular deposits in acid copper baths.

The sulphate radical present in many natural waters causes rough deposits in lead fluoborate solutions.

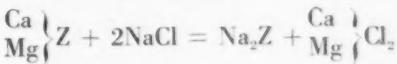
Hull & Wernlund<sup>5</sup> state that the first principle in bright zinc plating is the use of a plating bath virtually free from heavy metal impurities. Minute amounts of heavy metals markedly affect the color and brightness of the deposit. A similar statement with some modifications applies to most bright plating baths. It is indeed a safe practice to use as pure a water as possible.

The most efficient method of avoid-

ing contaminants in plating baths due to water is the use of ion exchangers. The ion exchangers have the ability to trade one ion for another. These materials, synthetic or natural, are either organic or inorganic in nature. Up to about 1935 the natural or synthetic sodium aluminum silicates were the only ones available for ion exchange purposes. They are known as zeolites. When hard water is filtered through a layer of zeolites the following exchange of ions take place: Let Z = zeolite



The zeolites give up their sodium ions and absorb the  $\text{Ca}^{++}$  and  $\text{Mg}^{++}$  from the water; and the resultant water is soft. When the zeolites give up all of their sodium ions, they are regenerated with sodium chloride according to the following reaction:



For the past ten years many organic anion and cation exchangers have been developed which, when used in combination, produce water which approaches distilled water in purity. The resultant water is often known as deionized or demineralized water.

When the raw water passes through the cation unit, all positive ions, i.e., calcium, magnesium, sodium, iron, copper are removed from solution and hydrogen substituted for them. Then the water passes through the anion unit where all anions are absorbed.

The cation exchanger is regenerated with acid and the anion exchanger with caustic soda or sodium carbonate.

An editorial dealing with water purification that appeared in the May, 1943 issue of *Metal Finishing* predicts that ion exchangers for water purification will be as common in the future plating rooms as filters are in our present ones.

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# Pickling and Bright Dipping

## Copper-Zinc Alloys

By GEORGE B. HOGABOOM—Consultant

*New Britain, Conn.*

THE two most commonly used copper-zinc alloys are high and low brass. High brass is an alloy of from 60 to between 75 and 80% copper and the balance zinc. Low brass alloys range from 80% to about 92% copper above which the term gilding metal or bronze is applied. The real bronzes, however, contain a percentage of tin. Gilding metal is used as the basis or the intermediate layer metal for rolled gold plate.

When brass, either high or low, is annealed in an open furnace or with a flame a scale is formed on the surface. A similar scale is formed when brass is brazed or soldered at a heat sufficiently high to make it "red" hot. This scale is a combination of oxides of copper and some zinc. Generally when brass is brought to a temperature required for good annealing or brazing most of the zinc volatilizes or is "burned out." This leaves a scale composed almost entirely of copper oxides.

The copper oxide is in two forms—the black and the red oxide—cupric or cuprous oxide.

The ratio of these oxides depends upon the annealing or brazing conditions. When a large amount of air surrounds the brass during the annealing or brazing, these oxides—scale—may be very heavy. In a neutral or a controlled gaseous atmosphere practically no oxides are formed and a relatively bright brass is obtained. The presence of oxidizing or reducing elements such as may be had from drawing compounds also influence the amount of oxides formed. If the atmosphere of an annealing furnace contains considerable amount of reducing element there is the probability that some of the copper oxide found may be reduced to metallic copper. The result is that small red spots of metallic copper develop on the annealed brass which will resist the action of the acids of a sulphuric acid pickle and also of the bright dip.

### Pickling

The general method to remove scale from brass is to "pickle" in hot sulphuric acid. The strength can be from 6 to 10% sulphuric acid by volume, at a temperature range from 140° to 160° F. Stronger "pickles" or those operated at higher temperatures do not necessarily remove the scale more rapidly.

Often the brass after being pickled in sulphuric acid has what appears to be a red stain. Recalling one of the early lessons in chemistry it will be remembered that "ous" gives "ites" and "ics" gives "ates". The black oxide of copper is cupric oxide and combines with the sulphuric

acid to form copper sulphate. The red oxide being cuprous oxide is not soluble in sulphuric acid and consequently is not completely removed from the annealed brass. Part of the cuprous oxide in the scale may be released by the solution of the cupric oxide and will be found in the bottom of the pickle tank as a red residue.

An incident is recalled where an installation was made to recover the copper electrolytically from the sulphuric acid pickle. Careful calculations had been made as to the amount of copper that was lost from annealing and removal of the scale. When the electrolytic unit was installed the copper that was recovered did not correspond to the expected amount. The red oxide of copper, which was insoluble in the sulphuric acid, had been overlooked in the original calculations. Where recovery of copper from pickling solutions is practiced it is advisable to have the annealing conditions so that a minimum amount of the red oxide of copper is formed.

If sodium dichromate is added to the sulphuric acid pickle the nature of the red oxide of copper will be changed to a condition in which it will be taken into the sulphuric acid. The amount of sodium dichromate was determined where the sulphuric acid used was calculated by weight, rather than by volume. In general terms this was found to be—a 6% sulphuric acid solution to which was added sodium dichromate in amounts corresponding to 1/6 of the weight of sulphuric acid used. In this solution the removal of the scale from brass is more rapid than when sulphuric acid alone is used. In general from 2-12 oz. of sodium dichromate can be used for each gallon of sulphuric acid pickle.

Ferric sulphate may be used instead of sodium dichromate. The pickling solution can be made of:

Sulphuric acid ..... 8-12% by wt.

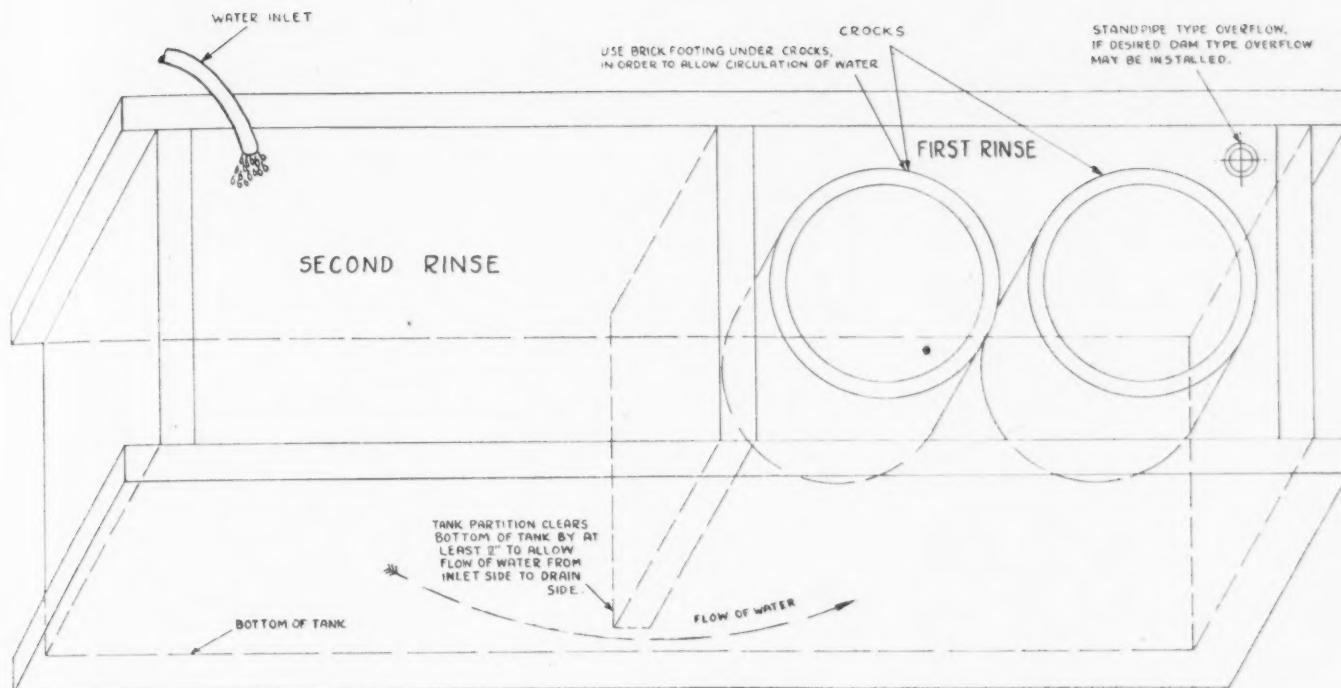
Ferric sulphate ..... 12% by wt.

Temperature—140°-160° F.

Brass that is pickled in sulphuric acid containing either sodium dichromate or ferric sulphate will have a semi-bright surface. For articles that do not require a highly lustrous finish the use of the scaling and bright dip can be eliminated.

It is the far better practice to remove scale from brass by pickling rather than to attempt to do it in a "scaling" dip. The time of removal of the scale will be shorter, the loss of metal will be less and the surface of the brass will be in a better condition to be bright dipped.

Articles made of brass which have been formed and



Partitioned bright dip tank. Note partition clears bottom of tank for underflow of water, preferable to overflow, from clean to dirty water compartment.

require a bright surface all over, or on the inside or recessed parts only previous to a subsequent operation or as a final finish, seldom have scale on them. The use of a sulphuric acid pickle on such articles is not common, although it has been suggested that a sulphuric acid pickle containing ferric sulphate may be substituted for the generally used "scaling" dip. It is the general practice to use a scaling dip previous to the bright dip.

The composition of scaling and bright dips has been given in literature and patents.

#### Scaling Dips

The scaling dip contains a high nitric acid content as that acid more readily attacks any oxides that may be on the surface of the article. At one time the scaling dip was known as the "black boil". Why, was never known. The nitric acid content of the formulas published in the literature varies considerably. It would be difficult to state definitely what the nitric acid content of the scaling dip should be because after the first batch of work is put through the dip some of the nitric acid is consumed and some goes off as nitrous oxide fumes. To endeavor to maintain a constant concentration of nitric acid, even an approximate content, would be a waste of time and effort. The rule of thumb, gained from experience, will probably always prevail. A common practice in making a new scaling dip is to add nitric acid to a spent bright dip until the desired results are obtained. Additions of nitric acid are made until the acids are so saturated with metal that the desired results are not obtained. The dip is then discarded. In some large installations the copper is recovered. In small installations the cost of labor required offsets the revenue from the copper sludge. Work can be handled in bulk or on wires and the time of immersion will depend upon the condition of the surface of the brass, but generally is a period of time that will fit in with the sequence of operations by the "dipper" as the operator is often called.

#### Bright Dips

As far back as the memory of many "old timers" goes, the formula for a bright dip has been 2 parts of sulphuric acid and 1 part of nitric acid. This is added to a small amount of the spent bright dip that has been discarded or partly used for the scaling dip. The action of a dip made from new acids is quite violent and considerable fumes are given off. The brass is rapidly attacked and the excessive fumes will stain the brass unless the articles are transferred very quickly to the rinse water which always results in a large drag-out of the acids. If some of the old bright dip is not available a pound or two of copper sulphate added to a 15 gallon dip will be equally as effective.

The use of the 2 to 1 bright dip, while common in a large number of dip units is not as economical, nor does it lend itself to a reasonable method of control as a mixture of equal parts of sulphuric acid, nitric acid and water. (1-1-1). This mixture is more easily made than when the acids are added by weight or by fractions of any quantity. When brass is immersed in a solution of the mixed sulphuric-nitric acid there should be sufficient water present so that the hydrated sulphate and nitrate of both copper and zinc are formed. These compounds required water in order to form crystals. Take the sulphates for example: copper sulphate is  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ ; zinc sulphate is  $\text{ZnSO}_4 \cdot 6\text{H}_2\text{O}$ . The nitrates in the crystallized form also have a definite water content  $\text{Cu}(\text{NO}_3)_2 \cdot 3\text{H}_2\text{O}$  or  $\text{Zn}(\text{NO}_3)_2 \cdot 3\text{H}_2\text{O}$ . If there is no water in the mixed acids which make the bright dip, the life of the dip will be very short. In the 2 to 1 mixed acids the success of the operations depends upon the amount of drag-in water. That is, no doubt, one of the real reasons why an old dip works better than a new bright dip. If water is required to form the crystals of copper and zinc then why not add water when the dip is newly made?

There is also a reason why a large volume of water should be present in the bright dip and that is to lengthen

the life of the dip by keeping it as cool as possible so that the dissolved copper and zinc will be crystallized and settle to the bottom of the crock containing the acids. It is for that reason also that it is necessary to have the container for the bright dip in cold running water. The acids, due to the reaction with the brass, become warm and, if not in a place where the dip will be cooled, become hot. Hot bright dips become ineffective due to the saturation of the acids with metal. The brass, until the acids are saturated, is violently attacked and there is a copious evolution of highly toxic and corrosive fumes. Where a good method is employed for maintaining the bright dip as cool as possible and the crystals of copper and zinc are precipitated, the amount of acid consumed is considerably less, the life of the bright dip increased and a better finish is produced on the brass.

The consumption of nitric acid, the most costly of the acids used in the bright dip, is considerably less in the 1-1-1 mixture than in the 2-1 acids due to the lesser amount of nitrous oxide fumes given off when the brass is bright dipped. This reduction in fumes also permits a longer time during which the work may be transferred from the acid dip to the rinse water.

The same procedure in making a new dip can be followed, that is, retaining a small amount of old dip or adding a small quantity of copper sulphate. To either mixture it is necessary to add a small amount of hydrochloric acid or common salt. Without these a hazy film will develop on the brass. The composition of this film is not known, but due to its removal by a chloride it is assumed to be zinc. An excess of either hydrochloric acid or common salt will cause a dullness of the finish of the brass. The amount generally used is from 2 to 6 fluid oz. of hydrochloric acid to each 10 gallons of the made up bright dip. The chemical control of the acids in a bright dip has been worked out but, where a bright dip is being used at full capacity, the control of the amount of each acid used is most difficult and is probably not a production restoration method. The temperature changes of the acid will affect the amount of copper or brass held in solution and, therefore, the amount of "free" or active acid available.

### Control of Bright Dip

A workable method for control of the 1-1-1 bright dip has been developed. If it is followed there will be a decreased consumption of nitric acid. With this control of acids a "smooth" bright finish will be obtained on brass rather than the "rough" bright surface often obtained from the 2-1 bright dip. The difference in the surface luster is due to the control of the nitric acid content of the bright dip. A high nitric acid content will etch the surface of brass so that the light reflection is not as good as when there is only a very slight attack of the brass. It is advisable, therefore, to use the smallest content of nitric acid in the bright dip that will give the desired results. A study of the bright dip will prove that the nitric acid is the medium for brightening brass but it can also, as stated, etch the brass to the extent that a "rough" bright surface is obtained.

A 1-1-1 acid bright dip will work well as soon as it is cool after preparation. There is a wide range of temperature so that a temperature control device is not necessary. By having the acid in a stoneware crock which is placed in a tank with sufficient running water, a workable temperature can be obtained. This same running water can be used as the first water rinse after bright dipping.

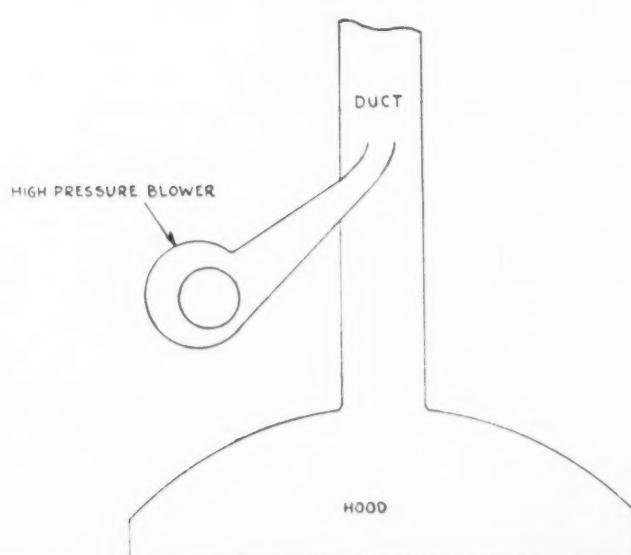
A good working 1-1-1 bright dip, after being used a few hours, on cooling to the temperature of the surrounding water will have a specific gravity ranging from 36° to 50° Bé. The optimum specific gravity is between 42° and 46° Bé. By keeping the specific gravity within these limits it is possible to control the effectiveness of the acids, and thereby obtain consistently good results.

The best practice is to use two bright dips where any volume of work is being processed. One bright dip, with reasonable care in drag-out of acids which is permissible with the 1-1-1 mixture, can be used for the work to be processed during a morning's operation. The volume of the mixed acids, of course, enters into this method and it should be sufficient to permit the use of the bright dip for approximately 4 hours. The other bright dip is to be used for the afternoon's operation.

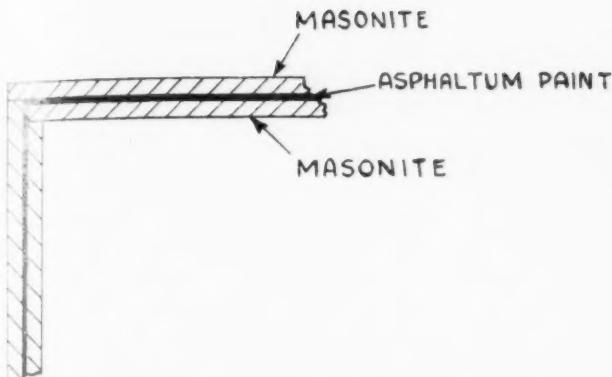
The first bright dip is permitted to cool until shortly before the end of the work day. Sufficient sulphuric acid and water should be added so that a specific gravity of 44° Bé is obtained when the volume of the dip is restored to its usual amount.

Before starting operations the following morning a piece of brass, used as a test piece, can be passed through the acids in the same manner as work being processed and the brilliance of the surface is noted. If not sufficiently bright just enough nitric acid is added to obtain the desired luster. A few trials will make the operator well acquainted with the approximate amount of nitric acid to be added. At the same time a small amount of hydrochloric acid is added. It will be found that the use of hydrochloric acid will be more convenient than the use of common salt. It may, however, be only matter of personal preference. The actual results will be the same.

The advantage of this procedure is two-fold. The "rough" surface of brass, due to high nitric acid content of a bright dip, has been discussed. It is well known that, if sulphuric acid is added to water or to the bright dip for replenishing, heat is evolved. If nitric acid is added while the bright dip is hot considerable fumes will be evolved which are nitrous oxide and represents a loss of nitric acid. There is no good



Eductor construction for exhaust hood to avoid corrosion of blower.



Double layer construction of exhausting system.

reason for this loss of nitric acid when it can be avoided by adding when the acid mixture is cool. The bright dip that has been used during the afternoon can be restored to the correct condition by adding the sulphuric acid the following morning and the nitric acid just before it is to be used again.

The saving in nitric acid by not using an excess and by eliminating the loss through fumes will not only be an economy but will result in a better finish on the surface of the brass. The dipping operations will be less hazardous as there will be less nitrous oxide fumes and the transfer time from the bright dip to the rinse water will not be so critical.

Bright dipped brass should be rinsed thoroughly so as to remove every trace of acid. The rinse tanks should have sufficient water supply to keep the final rinse practically free from acid. The general error with rinse water tanks is that the inlet and the outlet for the water is near the top of the tank. In such a condition the water in the bottom of the tank is not replaced rapidly enough to prevent it from becoming contaminated with acid.

To obtain a good flow of water in a bright dip unit the rinse tank should have two compartments. In one of the compartments the crocks containing the acid can be placed. The other side will be for the cleaner water. The center partition should extend from the top of the tank to within two inches of the bottom. The inlet for the water should be at the top of the tank used as the final rinse and the outlet at the far end of the section of the tank in which the crocks are placed. In this plan the water of both compartments will be kept clean as the flow of water will be from the top of the final rinse to the bottom of the first rinse and then out through the outlet at the far end of that tank.

#### Neutralizing

It is advisable to neutralize the acidic film of water that may remain on the brass to prevent tarnishing. This can be done and at the same time a very slight film of soap can be obtained on the work, which will protect the brass from tarnishing for several days. There is no necessity for producing of a soap film on the brass which will have a deleterious affect on a subsequent lacquer coating. In a separate unit make a solution of 4 oz. of neutral soap chips and 4 oz. of sodium cyanide to 25 gallons of water. This

should be kept warm—not hot. The brass articles, after rinsing in clean running water, are dipped into the soap-cyanide solution and then rinsed in clean running cold water—not the rinse water used after bright dipping. This cold water rinse will congeal a very slight film of soap on the brass—the cyanide will neutralize the acidity of the acid film on the brass. The work can then be passed through hot water for drying. The soap film will tend to shed the water more rapidly and thereby facilitate the drying.

Care must be used to have the brass well rinsed before putting into the soap-cyanide solution. If this is not done the acid carried into the soap solution will precipitate the soap as a fatty acid and a sticky gummy mass will adhere to the brass. It requires only a reasonable amount of care to carry out the neutralizing and drying operations.

It is too well known that aluminum, stoneware or Nichrome baskets must be used for bulk work. Nichrome baskets are preferable as they withstand considerable abuse and can be used for cleaning soiled work through alkali cleaners before bright dipping.

Vitrified stoneware will be found far more economical than the ordinary salt glazed crocks. Wood soot has long been used as a cover for bright dips but the scarcity of it does not allow its general use. Several years ago inquiries were made as to when and why wood soot was used. Brass "dippers" whose experience in the Naugatuck Valley (Connecticut), the home of the brass industry in this country, went back as far as the early 60's, stated that their fathers had used soot in England. It would be of interest to know when and why soot was used.

Wood soot not only acts as a cover to retard the evolution of acid fumes, it evidently has four different functions, each of which has a distinct advantage. First, as stated, it decreases the volume of the fumes given off; second, it conserves the nitric acid; third, it will remove any excess hydrochloric acid; and, fourth, it seemingly acts in the same manner as a "wetting agent". Graham found that bran middlings or the residue from the manufacture of wood pulp can be used as a substitute for wood soot. While either of these will give fair results, neither is as effective or has the life of wood soot.

It is essential to have a good exhaust system in any bright dip installation. The fumes given off are not only obnoxious but very toxic. They are also quite corrosive.

Hoods and ducts can be made of Masonite or Transite which will give longer service than either wood or metal even if painted. It is quite probable, however, that the newly developed wood which is impregnated with an acid resisting compound can be used, provided the expense is not too great.

In making the hood and duct it is advisable to use the double layer system with a good acid resistance asphaltum paint between each layer. The corners should be so constructed that no fumes can escape through the joints.

Instead of an exhaust type fan to remove the fumes a high pressure blower can be used. The fumes attack the fan and motor very readily and even when coated with an acid resisting paint they do not last very long. The moisture that is carried along with the fumes increases the corrosive properties of the fumes.

# Methods of Preparation of Aluminum for Electrodeposition

By HELMER BENGSTON

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## Introduction

MANY investigators have worked upon the problem of plating upon aluminum and various potentially good procedures have been advanced in the last three decades. As the application of aluminum and its alloys in industry broadens, the demand for finishes of all kinds increases. Electroplating occupies a prominent place among these finishes. Plating upon aluminum has been in considerable demand for certain wartime purposes. Copper has been applied to facilitate soldering. Silver has been required to provide good surface, electric contact, or good surface conductivity for high frequency currents. Brass has been applied to permit vulcanization of rubber.

One of the early important contributions to the art of plating upon aluminum was made by Travers<sup>1</sup> who found that when an aluminum article plated with nickel is heated to a moderately high temperature (about 240° C.) a pronounced improvement in adhesion results. The temperature at which this occurs is so low that the results are surprising.

Work<sup>2</sup> advocated deposition over a surface roughened by chemical etching so that the deposit became keyed into the etching pits produced in the aluminum surface. Fig. 1 is a reproduction of a micrograph taken from Work's paper. It is a section through a nickel deposit upon 2S alloy.\* The pre-plating treatment consisted of an etch in a solution containing nickel chloride and hydrochloric acid. The etching action in this case is accompanied by a deposition of metallic nickel by electrochemical displacement. Deep etching pits are evidenced, and these serve as anchors for the deposit of nickel. This and similar methods have been used in some commercial applications through the years.

Since that time two new and different commercial plating procedures have been developed, each of which produces smooth and adherent electroplates. These results are accomplished without application of heat. One method uses as a bonding layer an immersion coating of zinc, the other utilizes a bonding layer of aluminum oxide.

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\* For chemical composition of the aluminum alloys referred to, consult the table in the appendix.

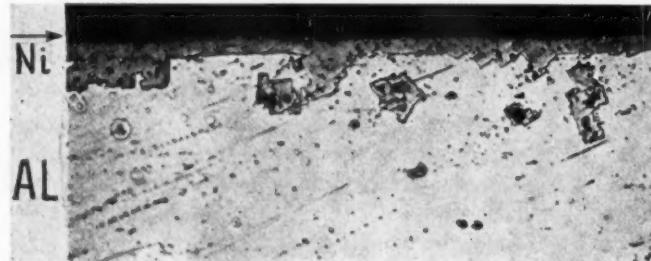


Fig. 1. Nickel plate on 2S aluminum. Preplating treatment is an etch in a nickel chloride-hydrochloric acid solution. (H. K. Work.)

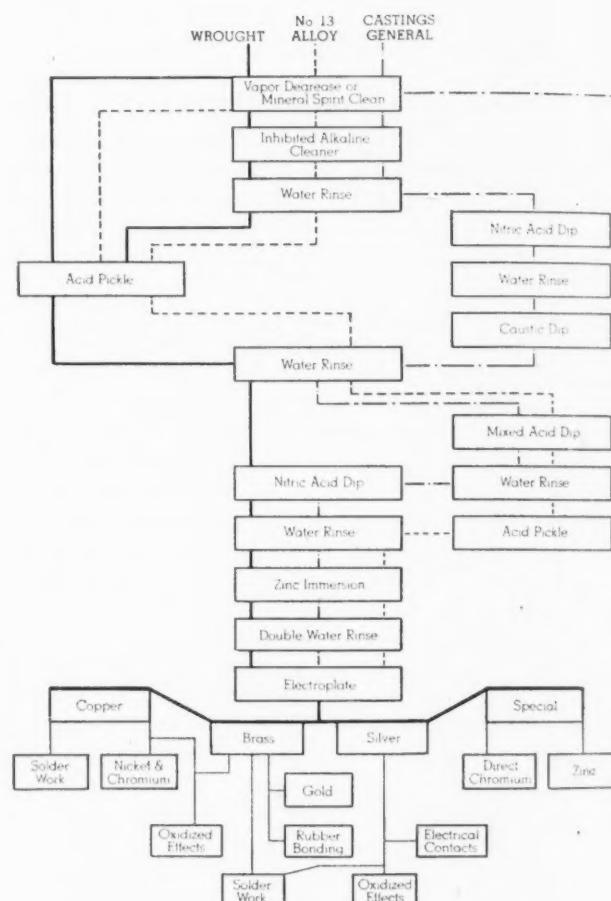


Fig. 2. Electroplating on aluminum. Zinc immersion process flow sheet.

## The Zinc Immersion Plating Procedure

Hewitson<sup>3</sup> describes a procedure for plating aluminum which involves the formation of a zinc immersion coating. Years passed before this procedure assumed commercial importance, but today it is creating much interest among electroplaters. The Aluminum Company of America laboratories have made contributions to this procedure which have helped to insure successful applications of electro-deposits. These contributions lie chiefly in the methods of preparing the aluminum surface prior to the application of the zinc immersion layer.

A typical procedure for wrought aluminum alloys follows:

1. Clean;
2. Chrome pickle\*\*;
3. Rinse;
4. Concentrated nitric acid dip;
5. Rinse;
6. Zinc immersion treatment;
7. Rinse;
8. Electroplate.

A more complete outline of the procedure is given in Fig. 2. This presents a flow sheet showing in a general

\*\* For chemical composition of the various special solutions used, consult the appendix.

way the procedures both for wrought alloys and for casting alloys.

The cleaning steps may be divided into two operations: grease removal and acid etching. Removal of oil or grease films permits a uniform attack in the subsequent acid etching operation.

Much of the success obtained by the zinc immersion procedure on wrought alloys is attributed to the use of the acid pickle solution. The chrome pickle produces a slight etch upon the surface of the aluminum, but it is not sufficient to impair the surface smoothness of the subsequent electrodeposit. The weight loss resulting from this treatment upon 2S alloy is 0.113 mg./cm.<sup>2</sup>. Although referred to as an etch, this treatment permits applying copper and bright nickel without intermediate buffing.

The treatment of aluminum casting alloys differs in that the mixed acid etch is used in place of the chrome pickle. The mixed acid etching solution is a mixture of nitric and hydrofluoric acids. Most casting alloys contain silicon, and only by means of hydrofluoric acid can a residual film of silicon be avoided.

The effect of the etching procedures and the improved quality of the zinc immersion coating may be the result of one or more of various reactions: (1) the particular etching solution may leave a desirable form of oxide coating; (2) the irregularities produced in the surface by the slight etch may contribute to the degree of adhesion of the zinc layer; (3) the improved quality may be due to the removal of undesirable inclusions from the surface. The third of these possible effects is considered to be the most important. It is believed that some surface impurities, if not removed, might set up local cells and cause deposition of zinc in a form which would not be adherent. In substantiation of this claim it has been found that a buffed surface which would be more free from inclusions offers less cause for trouble in plating than an unbuffed surface. An etching agent which removes undesirable inclusions without excessively roughening the surface should therefore produce good plating results. The recommended etching agents are believed to fulfill these requirements.

After the aluminum article has been prepared as de-

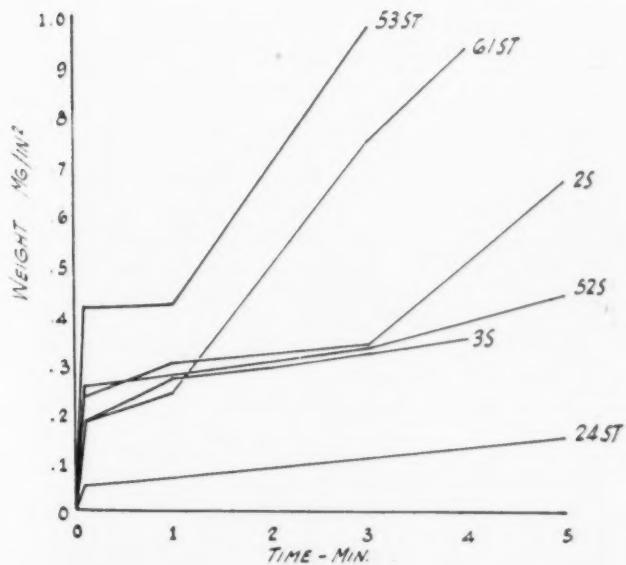


Fig. 3. Effect of aluminum alloy composition on weight of zinc deposits.

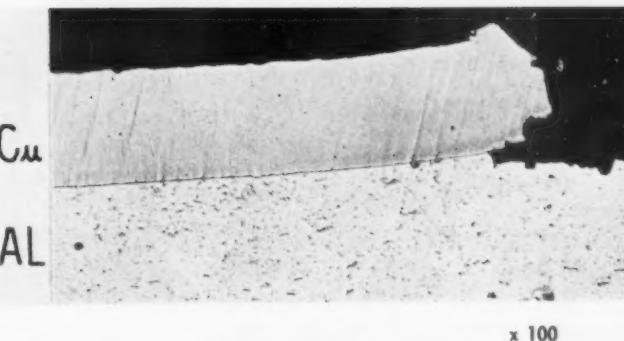


Fig. 4. Copper plate on 3S aluminum. Preplating treatment is according to the zinc immersion procedure. Portion of Cu deposit is torn from the basis metal.

scribed, it is immersed in the sodium zincate solution. The mechanism of the reaction in the zincate solution involves first the removal of the superficial oxide film which develops after the acid etching treatment. As soon as the bare metal surface is exposed, some aluminum goes into solution, but the aluminum dissolved is replaced by an equivalent weight of zinc. These successive reactions make possible an intimate union of the aluminum and the zinc layer. The following figures indicate the magnitude of these chemical changes. In this case 2S aluminum alloy was immersed for two minutes in the alkaline sodium zincate solution at room temperature.

	mg./cm. <sup>2</sup>
Weight aluminum dissolved	0.017
Weight of zinc immersion coating formed	0.057
Theoretical equivalent of zinc based upon weight of aluminum dissolved	0.062

The deposit produced in the zinc immersion solution is believed to be largely metallic zinc, for it in turn will produce a continuous though non-adherent immersion coating of silver from a cyanide silver solution. A further indication that the deposit is metallic is evidenced by the fact that there is no appreciable potential drop between the basis metal and subsequently deposited silver, as is the case when an electroplate is applied over an oxide coating.

If the operating conditions are correct, the deposited zinc is smooth and lustrous. It varies considerably in appearance, depending upon the aluminum alloy upon which it is applied. On copper-bearing aluminum alloys it is scarcely detectable. On many alloys a slate gray film is produced. The effect of alloy composition upon the weight of zinc deposited is indicated in Fig. 3. It is observed that the zinc film grows rapidly during the first few seconds of immersion, but thereafter it increases in thickness at a much slower but uniform rate.

The difference in weight of the zinc deposits produced on the various alloys does not seem to have any influence upon the quality of adhesion of the subsequently applied electroplates. The time of immersion is not too critical, but is generally within the range of 1 to 2 minutes.

There are certain deviations from the general procedure outlined above. For copper-bearing alloys the zinc oxide of the zinc immersion solution is preferably replaced with an equivalent amount of zinc sulfate. The reason for improved results with the modified solution is not known. The weight of zinc deposited from the two types of solution

on 24ST alloy is identical. For 61ST alloy, which contains a small amount of silicon, it has been found advantageous to add 5 ml./L of 48% HF solution to the chrome pickle solution.

The surface preparation treatment described above involves, at most, a period of 3 to 5 minutes, and is therefore not unlike the preparation treatments used for plating upon other basis metals.

After the zinc immersion coating has been applied, the aluminum is ready for electroplating. Various electro-deposits can be applied over the zinc layer, such as copper, brass, silver, chromium and iron. Nickel has been deposited from special solutions developed for plating over zinc. Zinc can be deposited from the pyrophosphate type solution. Deposits from the zinc cyanide solution will blister. If cadmium is deposited over the zinc immersion layer from a cyanide solution, the deposit at first shows evidence of good adhesion, but after a few hours the deposit becomes blistered and fails severely upon burnishing. This phenomenon has not been satisfactorily explained, but it may be caused by alloying between the cadmium and the zinc.

That the electrodeposit forms upon the zinc immersion layer and does not replace it can be demonstrated by dissolving the copper plate from a specimen by means of an ammonium carbonate solution in the presence of an oxidizing agent. The original zinc layer is exposed after the copper has been removed.

The quality of the bond produced by the zinc immersion method is indicated by the fact that copper, so plated, can be used as a base for soldering, and there is no evidence of blistering upon heating.

For wrought alloys at least, the rupturing force required to separate the electrodeposit and the basis metal appears to be approximately equal to the tensile strength of the alloy. The instrument devised by Mesle has been used for evaluating adhesion. The possibility of evaluating bond strength by means of shear test measurements is being investigated. Tests upon the adhesion of electrodeposits applied to castings indicate that less force is required to remove the deposit than for the removal of similar electrodeposits applied to wrought alloys. Here too the basis metal tears, but the physical properties of the basis metal are inferior. The following photomicrographs further illustrate the nature of the bond produced by this plating method.

Fig. 4 shows a photomicrograph of a section through a heavy copper plate on aluminum. A portion of the copper plate has been pried away from the aluminum and pulled back until it fractured. Section B-C illustrates that in tearing away the electroplate the aluminum surface was

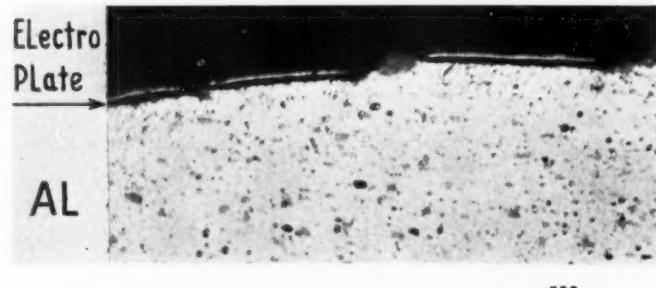


Fig. 5a. 0.0008 in. Cu (2 microns) and 0.0008 in. Ni electro-deposit on aluminum. Preplating treatment is according to the zinc immersion procedure. The plated sheet was bent sharply after electroplating.

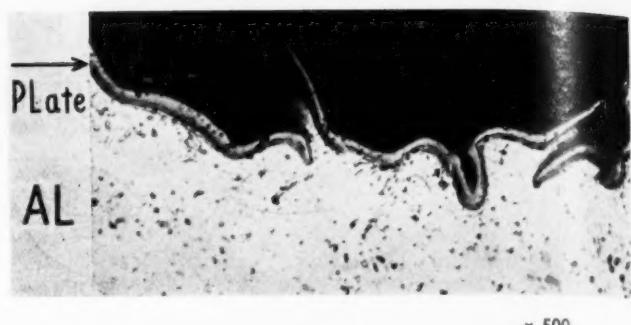


Fig. 5b. 0.0008 in. Cu and 0.0008 in. Ni electrodeposit on aluminum. Preplating treatment is according to the zinc immersion procedure. The plated sheet was bent sharply after electroplating.

severely torn. This indicates that the bond strength is greater than the cohesive strength of the aluminum alloy. Section A-B indicates the smoothness of the interface. Compare this interface with that illustrated in Fig. 1.

Fig. 5a and 5b are photomicrographic sections through sharp bends in copper- and nickel-plated aluminum sheet. The harder electrodeposit fractured on the outside of the bend, and wrinkled severely on the inside of the bend, but nowhere is there any evidence of bond failure.

Fig. 6 presents a section along the length of aluminum wire which had been silver plated at 0.040 in. (1 mm.) diameter and subsequently drawn to 0.0034 in. (0.086 mm.) diameter. Even with such severe treatment, there is no evidence of failure of the bond.

The zinc immersion process is applicable to barrel plating as well as to still plating. It should likewise lend itself to full automatic plating requirements.

#### The Anodic Coating as a Base for Electroplating Upon Aluminum Alloys

The thin oxide coating which protects aluminum alloys against corrosion has in the past been considered one of the obstacles in plating upon aluminum. It has been found that if this naturally formed thin oxide coating is replaced with a suitable electrolytically formed oxide coating, it will serve as a base for electroplating and will form the bond between the aluminum basis metal and the electroplate.

Travers<sup>4</sup> describes a procedure by which aluminum alloys are anodically coated with either d.c. or a.c. in any one of a number of electrolytes. The coating formed is then partially removed by chemical treatment to render it receptive to an electroplate.

Fischer<sup>5</sup> describes the use of a phosphoric acid electrolyte in preparing aluminum for electroplating. He prescribes the adjustment of anodic coating conditions in the phosphoric acid electrolyte so that an oxide layer forms which is sufficiently porous to permit metal deposition from an alkaline plating solution. He refers to a partial detachment of the oxide coating in the alkaline plating solution. In other words, Fischer relies upon the alkalinity of the plating solution to so modify the oxide coating that an electroplate may be formed, whereas Travers depends upon an intermediate chemical treatment for the modification of the oxide coating. Fischer suggests the following operating conditions: electrolyte, 3%  $H_3PO_4$  (by vol.); temperature, 40° to 50° C.; voltage, 90 to 100 volts; time, 5 minutes.

The Aluminum Company of America has explored the possibilities of anodic treatment in the phosphoric acid

electrolyte as a means for preparing aluminum for electroplating. It has been found that, by proper selection of the anodic coating conditions, an oxide coating can be applied to the surface which is suitable for applying an electroplate. Selection of optimum conditions was effected by systematically exploring the ranges in electrolyte concentration, electrolyte temperature, applied voltage, and duration of anodic treatment, and studying the effects upon the electroplating results obtained. The plating solutions used were primarily Unichrome copper\* and H-VW-M semi-bright cobalt-nickel.\*\* The former solution was operated at pH 7.5 and the latter at pH 3.7. The control ranges for the phosphoric acid electrolyte are much narrower in preparing aluminum for nickel plating than they are for copper plating. The cyanide type plating baths have also been used, but the results obtained depend in part upon the rate at which the basis metal becomes covered with the electroplate. In recesses there is the danger that the strongly alkaline solutions may attack the oxide coating before it is completely covered with metal, and thereby impair the quality of the electroplate bond.

In this procedure the anodic treatment conditions are so selected that the oxide coating formed is in a proper condition for electrodeposition. Any modification by an alkaline solution alters the coating to such an extent that the optimum condition is lost.

The phosphoric acid electrolyte operating conditions vary, depending upon the composition of the various aluminum alloys. As an example of the procedure used, 3S is prepared for Unichrome copper plating by anodically coating under the following conditions: electrolyte, 354 g./L  $H_3PO_4$ ; temperature, 32° C. (90° F.); current density, 1.3 amp./dm.<sup>2</sup> (12 amp./sq. ft.); time, 10 minutes. After rinsing, the work is immediately transferred to the plating solution. In this particular case the same set of anodic coating conditions are also suitable for preparing the surface for nickel plating.

In plating over the oxide coatings, deposition takes place initially within the structure of the oxide coating. During the first few moments of plating the oxide coating turns dark in color, but thereafter the surface acquires the characteristic appearance of the deposited metal. Travers<sup>6</sup> states that the initial dark deposit is, in the case of nickel plating, an oxide of nickel, but such dark initial deposits appear with the various metals that have been deposited

\* United Chromium, Inc., New York, N. Y.

\*\* Hanson-Van Winkle-Munning Co., Matawan, N. J.



Fig. 6. Silver-plated aluminum wire. Preplating treatment is according to the zinc immersion procedure. The wire was plated at 0.040 in. (1 mm.) diam. and drawn after electroplating to 0.0034 in. (0.086 mm.) diam.

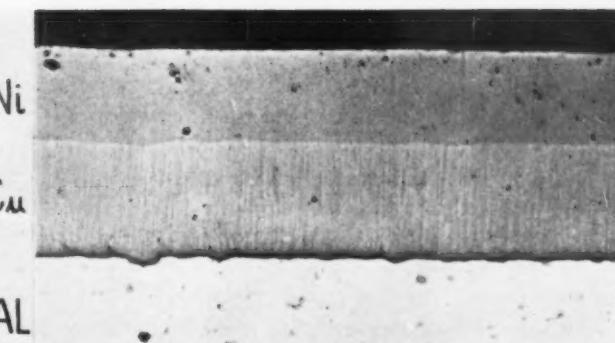


Fig. 7. Heavily copper- and nickel-electroplated 3S aluminum. Preplating treatment by anodic oxidation in phosphoric acid electrolyte.

over the oxide coatings. It is therefore believed that these dark deposits are finely divided metal.

The presence of the oxide under the electroplate has been questioned in the past, but its presence is readily demonstrated. The electroplate of copper, for example, can be dissolved in concentrated nitric acid and the re-exposed oxide coating dyed by immersion in a suitable anodic coating dye solution. Additional evidence is given below.

Electroplates, when properly applied over the oxide coating, are smooth and have excellent adhesion. Tests have shown (as in the case of electrodeposits over the zinc immersion coating) that the bond strength is greater than the cohesive strength of the basis metal.

Fig. 7 is a photomicrograph of a section through a 3S alloy specimen which has been given the phosphoric acid anodic treatment and plated first with a heavy copper deposit, and then with a heavy nickel deposit. The aluminum-copper interface shows some irregularities, but is relatively smooth as compared with that of Fig. 1. The oxide coating is too thin to be revealed in the micrograph.

The anodic treatment procedure is not applicable for electroplated surfaces requiring good electric conductivity due to the resistance through the oxide coating. This effect is evident from the following tests made with 2 in. x 4 in. (51 mm. x 102 mm.) aluminum sheet specimens:

Time of Anodic Treatment in Phosphoric Acid	Resistance Between Silver Plate and Aluminum (Microhms)
Blank	18
4 minutes	170
6 minutes	300
12 minutes	650

For good electric conductivity the zinc immersion procedure is preferred to the anodic coating procedure.

A limited amount of work has been done with sulfuric acid as the electrolyte for producing anodic coatings on aluminum to be used as a basis for electroplating. Coatings formed in this electrolyte are evidently denser than those formed in phosphoric acid. With copper-bearing alloys only, such as 24ST, which normally form a more porous structure, were coatings obtained that could be directly electroplated with copper or nickel.

#### Corrosion Resistance of Plated Aluminum

Claims have been made to the effect that an intermediate

oxide coating between the aluminum and the electroplate adds to the corrosion resistance of the finished article. No data are yet available, but tests are under way in which the anodic coating surface preparation is being compared with the zinc immersion surface preparation.

The corrosion resistance of soldered joints, where copper plating by the zinc immersion method has been applied to facilitate soldering, is excellent provided the proper solder has been used (such as Alcoa No. 802 solder) and provided the unnecessary, exposed copper plate has been removed.

Until more data are available it is assumed that plating specifications for copper and nickel on aluminum alloys must be identical with those for steel or for zinc. These metals, copper and nickel, are cathodically protected by aluminum and must therefore be impervious to afford good corrosion resistance to the aluminum.

### Zinc-Plating Aluminum

It is possible to zinc-plate aluminum by a method which is as simple as any of the commercial plating procedures used for other basis metals. Zinc electroplates upon aluminum have two properties that may be of value commercially. They have been applied to a limited extent commercially to threaded parts where they serve as an antiseize medium in such cases where oil cannot be used. Zinc also offers cathodic protection to certain aluminum alloys, and has been attached as expendable zinc lugs to aluminum equipment, where it dissolves in preference to the aluminum. Zinc could likewise be applied as an electroplate to protect such aluminum alloys.

It has been stated above that zinc may be deposited from the pyrophosphate type electrolyte over the zinc immersion coating, and that under some conditions it may be applied over the anodic coating. The procedure outlined below is, however, much more simple than either of the procedures previously described.

### Preparation of Aluminum for Cyanide Zinc Plating

1. Clean.
2. Acid dip.
  - a. Chrome pickle, 5 minutes.
  - or b. Mixed acid dip, 15 to 30 seconds.
3. Rinse.
4. Plate in standard cyanide zinc solution, 5 minutes at 0.32 to 0.54 amp./dm<sup>2</sup>. Continue at normal current density about 1.64 amp./dm<sup>2</sup>.
5. Rinse and dry.

In contrast with the results obtained with the above procedure, an etch in a 50 g./L NaOH solution, followed by a nitric acid dip, produces a severely blistered deposit. This difference in results has not been accounted for.

### Conclusion

Two general and one special procedures for preparing aluminum for electroplating have been described. With the possible exception of the special procedure for depositing zinc upon aluminum alloys, the acceptable commercial methods for preparing aluminum for plating are quite unlike the procedures normally used for plating upon other basis metals. Many different aluminum alloys are being used commercially and these exhibit widely different properties. Accordingly, it is to be expected that certain alloys

might be plated by procedures not common to the entire group. This has led to the disclosure of plating procedures for aluminum which have had only limited usefulness.

In the zinc immersion procedure a method for plating upon aluminum is available which is applicable to all of the aluminum alloys listed in the appendix, with only minor variations in preliminary cleaning operations. There are some differences in the results obtained depending upon the physical properties of the alloy, whether it be of wrought or cast structure. The bond in all cases appears to be stronger than the cohesive strength of the basis metal. No more than this can be expected of any plating procedure.

The use of an aluminum oxide bonding layer is also generally applicable. The electroplating results obtained are equally as good as those obtained by the zinc immersion method, but the oxide procedure is more critical and requires more time and equipment than the zinc immersion procedure. For most purposes the anodic coating procedure is therefore considered to be of secondary importance.

With a wider commercial application of electroplating to Aluminum alloys in the postwar era, further refinements in the procedures will undoubtedly result.

### Acknowledgments

The writer wishes to acknowledge the assistance of the personnel of the Finishing Division for the work from which the data are taken. Acknowledgment is also due the Metallurgical Division of the Aluminum Company of America Research Laboratories for the photomicrographic work.

### Appendix

TABLE I

#### Nominal Composition of Wrought Aluminum Alloys\*

Alloy	Per Cent Alloying Elements—Aluminum and normal impurities constitute remainder.				
	Cu	Si	Mn	Mg	Cr
2S					
3S				1.2	
24ST**	4.5		0.06	1.5	
52S				2.5	0.25
53S			0.7	1.3	0.25
61ST	0.25	0.6		1.0	0.25

\* Only those alloys referred to in this paper are incorporated into the table.

\*\* T designates heat-treated temper.

TABLE II

#### Special Solutions

##### Chrome pickle

175 g./L H<sub>2</sub>SO<sub>4</sub>; 35 g./L CrO<sub>3</sub>.  
Temperature, 65.6° C. (150° F.).  
Time, 1/2 to 2 minutes.

##### Zinc Immersion

400 to 500 g./L caustic soda; 75 to 100 g./L zinc oxide.  
Temperature, 26.7° C. (80° F.).  
Time, 1/2 to 2 minutes.

(Concluded on page 232)

# Diffused Nickel-Zinc Coatings

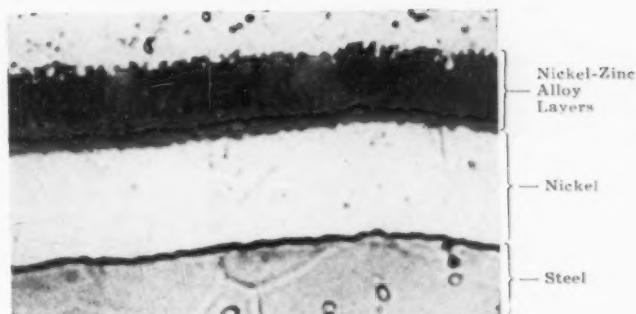
By GEORGE BLACK

Baltimore, Md.

THE comparatively short history of electroplating developments is chock full of evidence of man's ingenuity. One of the most fascinating of these discoveries is illustrated by the Corronizing process, which succeeds in tremendously increasing resistance to corrosion through the deposition of two distinct layers of plating and the subsequent controlled application of heat. The resistance of the coating thus formed is many times greater than that afforded by the applied metals either individually or as a duplex coating.

The trade name Corronizing, covers two separate types of metal coatings; namely nickel-zinc and nickel-tin. The former offers superior protection and is especially useful where severe corrosive conditions resulting from moisture, fumes, brines and heat are to be encountered. The nickel-tin type is non-toxic, and has found wide use in the food container field. It is the purpose of this paper to discuss the nickel-zinc coating in detail. Therefore, unless specifically stated to the contrary, all statements, references and data which follow will relate to the nickel-zinc coating.

Electroplate can be no better than the surface upon which it has been applied. The importance of pre-cleaning can not be overemphasized. But the process requires no special care of treatment which is not demanded by all plated coatings. It is recommended that degreasing, electro-cleaning, acid pickling and general surface preparation be



Microphoto of Corronized Layers.

accomplished with high quality commercially proven methods, equipment and procedures. The deposition of the nickel layer should be accomplished using standard Watts nickel plating baths, and any of the standard alkaline or acid zinc plating solutions will provide satisfactory zinc coatings. The only precaution which must be taken to insure the full effect of the diffused coating is the avoidance of special addition agents or brighteners.

With this one exception, the nickel or zinc layers may be applied to ferrous and cuprous alloys in any form in which they can be successfully electroplated. Conventional procedures for racking, current density, solution and temperature control, are the same as those which have been established over years of development in the plating industry.

Up to this point Corronizing is no more than a regulation duplex coating, and the protection afforded is a function of the thicknesses of the applied metals acting individually. Now, however, the duplex coating is subjected to controlled heat treatment which results in the impregnation of the nickel with the zinc. The alloy thus developed can readily be traced on the zinc alloy phase diagram. (Fig. 1) The five layers of defense formed out of the original two are as follows:

1. pure nickel (closest to the metal)
2. Alpha alloy nickel-zinc
3. Beta alloy nickel-zinc
4. Gamma alloy nickel-zinc
5. Delta alloy nickel-zinc

Each of these layers is distinct as to composition, corrosion resistance, abrasion resistance and galvanic position. The outermost layer, delta alloy, is the least noble, with each succeeding layer progressively more noble, until the very noble nickel plated basis metal is reached. In this way many lines of defense are set up against corrosion, and the resultant progression is unusually efficient. For example, a 0.0003" diffused coating on steel sheet showed only 2% rust after 1,536 hours of exposure to salt spray at 95° F. Ordinary zinc electroplate tested at the same time, showed

(Concluded on page 209)

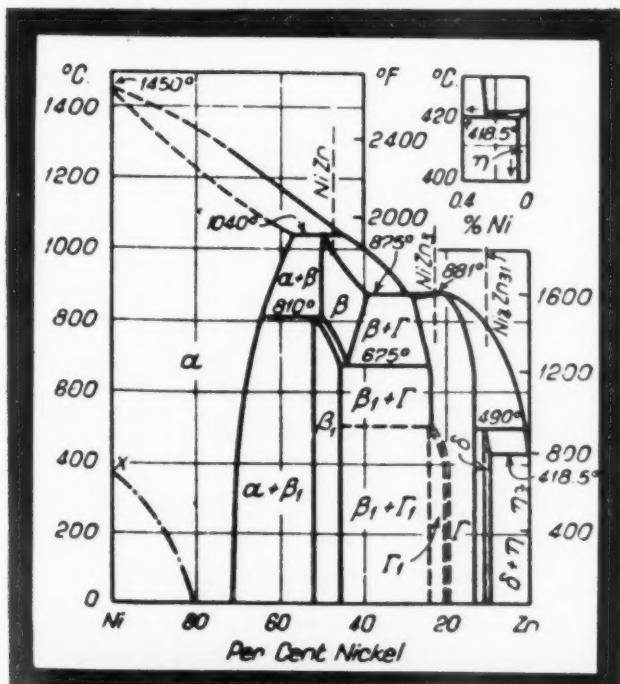


Fig. 1. The Nickel Zinc Alloy Constitution Diagram.

## THE DETERMINATION OF COBALT

By A. Norman Hixson and Wallace M. McNabb

**Department of Chemistry and Chemical Engineering  
University of Pennsylvania, Philadelphia, Pa.**

A method is described for the determination of cobalt in the presence of iron and nickel, using a photoelectric colorimeter and nitroso-R-salt, which is suitable for certain control work.

THE Klett-Summerson photoelectric colorimeter was found to be satisfactory for control purposes in the determination of cobalt in the presence of nickel, following the removal of iron. After an attempt to separate the nickel and cobalt by selective precipitations, both the residues and the filtrates were analyzed for cobalt using the red color formed with nitroso-R-salt. The interference of large amounts of ferric iron, which in some cases had not been removed by precipitation, was extracted with isopropyl ether and the color reaction for cobalt applied.

### Cobalt reacts with nitroso-R-salt



to give a soluble red complex salt in a sodium acetate medium. The red cobalt solution is stable on the addition of nitric acid and boiling, whereas most of the other metal complexes are decomposed. Small amounts of manganese, iron and nickel do not interfere.

The advantage of the colorimetric method is the short time required to complete a number of determinations as compared to the gravimetric method using  $\alpha$ -nitroso- $\beta$ -naphthol as the precipitant. Also, in these particular analyses the cobalt, as determined by the gravimetric method was never satisfactorily reproducible. The only good volumetric method is the one described by Tomicek and Freiberger<sup>1</sup>. They recommend the titration of cobalt to the trivalent state in an ammoniacal citrate solution with ferricyanide. The endpoint is determined potentiometrically by adding an excess of ferricyanide and back titrating with a standard cobalt sulfate solution. If manganese is present, it is oxidized quantitatively to the trivalent state so that the titration gives the sum of the cobalt and manganese. A manganese determination is required to obtain the cobalt content.

### *Reagents and Apparatus*

Nitroso-R-salt ..... 2.5 gms. per 500 ml. of water  
 Sodium Acetate ..... 500 gms. per 1000 ml. of water  
 Nitric Acid ..... 16 N  
 Standard Cobalt Sulfate solution ..... 0.01439 gms. per liter  
 Klett Summerson Photoelectric Colorimeter with test tubes  
 and #54 Filter.

## **Experimental**

A solution was prepared to contain approximately 24 gms. per liter of iron; 16 gms. per liter of nickel, 2.3 gms. per liter of manganese, and 1.3 gms. per liter of cobalt. The iron was completely oxidized and removed by chemical means and the filtrate containing the nickel, cobalt and

manganese was adjusted to a volume of 1 liter. Fifty-milliliter aliquots of this solution were used for experimental work on the selective precipitation of the three metals. The method described was found satisfactory for the determination of cobalt in these solutions.

### *Blank Correction*

Since the nitroso-R-salt is yellow in an aqueous solution, it is necessary to make a blank correction for the color of the reagent. Transfer 5 or 10 ml. of distilled water to a 150-ml. beaker and add 10 ml. of sodium acetate solution and heat to boiling. Add 5 ml. of concentrated nitric acid (16 N) and continue boiling for one minute. Cool to room temperature and transfer the solution to a 100-ml. volumetric flask. Rinse the beaker twice with small portions of distilled water. Dilute the contents of the flask to the 100-ml. mark. Mix the solution thoroughly. Rinse out the colorimeter tube several times with the solution and fill the tube to the 10-ml. mark. Rinse the outside of the tube with distilled water and dry with a soft cloth or tissue. Place the tube in the colorimeter containing a #54 filter. The tube should be placed in the same position each time. Turn on the light and allow to stand five minutes. Release the galvanometer needle and adjust until it coincides with the zero mark. The blank should be checked from day to day.

### **Calibration of Instrument**

Transfer 5 or 10 ml. of the standard cobalt sulfate solution to a 150-ml. beaker and add 10 ml. of sodium acetate solution, 10 ml. of nitroso-R-salt solution and heat to boiling. Add 5 ml. of conc. nitric acid (16N) and continue boiling for one minute. Cool to room temperature and transfer the solution to a 100-ml. volumetric flask. Rinse the beaker with small portions of distilled water and dilute the contents of the flask to the 100-ml. mark. Mix thoroughly and rinse the colorimeter tube twice with the solution and fill the tube to the 10-ml. mark. Clean and dry the outside of tube and place in the same position in the colorimeter as the blank. Turn on the light and, after standing a few minutes, release the galvanometer. Adjust the pointer to the null point by moving the dial. The number of scale divisions read from the dial represents the amount of cobalt in 5 or 10 ml. of standard solution. Repeat doubling the amount of standard solution. This gives twice the number of scale divisions within  $\pm 1$  or 2 divisions. A direct proportion exists so that plotting scale divisions against mg. of cobalt gives a straight line. The most accurate reading is obtained between 100 and 200 scale divisions.

### *Unknown Solution*

An unknown solution containing a large amount of nickel should be diluted so that the nickel ion color is not present during the final determination. This is accomplished by transferring 5 ml. of unknown solution to a 100-ml. volumetric flask and diluting to the mark. If

necessary, further dilution can be made.) Transfer 5 ml. of the solution to a 10-ml. flask. Dilute to the mark, thoroughly mix and transfer 5 or 10 ml. of the solution to a 150-ml. beaker and continue as given under procedure for standard. The scale division readings are compared with those obtained from the standard and the result in milligrams is calculated to grams per liter.

In the presence of ferric iron, a measured volume (10 to 20 ml.) is transferred to a beaker or small erlenmeyer flask and evaporated almost to dryness. The solution is transferred to a 125-ml. separatory funnel by rinsing the container with 35 ml. of 7.8 normal hydrochloric acid. To this is added 35 ml. of pure iso-propyl ether. This solution is shaken for two minutes and the water layer allowed to drain into a second separatory funnel and the extraction repeated. A third extraction is made and the water layer allowed to drain into a 125-ml. erlenmeyer flask. The flask is held in hot water until most of the ether has evaporated, after which direct heat is applied and the excess hydrochloric acid is expelled. The two or three ml. remaining in the flask are transferred to a volumetric flask, diluted and the determination of cobalt carried out in the usual way.

### Discussion

The solutions for analysis were hydrochloric acid solutions of iron, nickel, cobalt and manganese. Selective precipitating agents used for the separation of the metals were destroyed by boiling. Interfering ions for the determination of cobalt, such as cyanides, peroxides, persulfates and reducing agents were absent. The volumes of solutions were measured in large graduated cylinders. The major source of error was the inaccuracy of these volume measurements which could be of the order of one per cent. It can also be seen from the data that the cobalt method is more accurate than the gravimetric determination of nickel by the glyoxime method. The letters A, B, and C given in the table represent the filtrates and solutions formed by dissolving the precipitates in hydrochloric acid. The final volumes of solutions for analysis ranged from 200 to 450 ml. The nickel and manganese were determined as well as the cobalt and calculated to grams per liter.

If nickel is present in large amounts and only traces

of cobalt are present, the nickel should be removed and the cobalt determined in a less dilute solution in order to give a greater scale division reading and thus a greater degree of accuracy. For further information of transmission and adsorption of light for the red cobalt color and application to determination of traces consult "Colorimetric Determination of Traces of Metals".<sup>2</sup>

### Literature Cited

1. Tomicek and Freiberger, J. Amer. Chem. Soc. 57, 801 (1935).
2. Sandell, E. B., "Colorimetric Determination of Traces of Metals", p. 201, New York, Interscience Publishers, Inc. (1944).

\* Determination of Cobalt in the presence of Nickel, Manganese and Traces of Iron.

Results are given in grams per liter.

	Cobalt	Nickel	Manganese
#1 A	1.14	16.12	1.09
#1 B	0.18	0.10	1.10
Total	1.32	16.22	2.19
#2 A	1.05	16.04	0.56
#2 B	0.26	0.39	1.54
Total	1.31	16.43	2.10
#3 A	0.63	16.62	none
#3 B	0.68	0.19	2.12
Total	1.31	16.81	2.12
#4 A	0.61	16.20	none
#4 B	0.09	0.24	trace
#4 C	0.59	none	2.10
Total	1.29	16.44	2.10

\* These selected results are representative examples taken from about fifty analyses.

ranges. Conventional heat treating equipment such as gas or electrically heated tempering furnaces with recirculating air, salt baths, oil baths, radiant gas burner units and induction heating units will suffice for the diffusion of the nickel and zinc.

When properly treated, the nickel-zinc diffused coating appears a semi-lustrous slate gray color. It is perfectly smooth and will not peel, crack or flake when bent around a diameter equal to the thickness of the sheet upon which it has been applied. The coating will stand forming and drawing operations. In addition, it may be soldered, brazed spot and arc welded with a minimum loss of corrosion resistance.

Paint adhesion to these coatings is comparable to or slightly better than to plain steel. To insure maximum adhesion however, phosphate coatings can readily be applied.

The process is available to industry under a license agreement with Standard Steel Spring Co., Coraopolis, Pa.

# SHOP PROBLEMS

PLATING AND FINISHING  
POLISHING—BUFFING  
CLEANING — PICKLING  
HOT DIP FINISHES

METAL FINISHING publishes, each month, a portion of the inquiries answered as a service to subscribers. If any reader disagrees with the answers or knows of better or more information on the problem discussed, the information will be gratefully received and the sender's name will be kept confidential, if desired.

## Plating Phonograph Records

**Question:** We are experimenting in plating on phonograph records made of cellulose-acetate.

Our equipment consists of a 30" x 30" x 30" lead lined tank, lead heating coil, lead air-agitation coil. Acid copper solution consists of 27 oz. copper sulphate, per gallon, 6 oz. sulphuric acid per gallon, temperature 75°-110° F.

Our problem is this:

We cannot use a current density over 5-10 amp./sq. ft. without getting a very rough, large crystal, treed, powdery deposit which brushes off. We understand these records can be plated 0.030"-0.060" thick in 24 hours or less. We plated 0.014" thick, (a very poor deposit), in 22 hours. How can we get a harder, thicker deposit in less time?

F. W. M.

**Answer:** The discs should be rotated and the solution should be continually filtered for high speed plating. We would suggest that the solution be analyzed and that the temperature be maintained at 110° F. Since a range of 75° to 110° is too broad.

## Blue Steel Finish

**Question:** Could you furnish me a formula or procedure on obtaining a genuine blue steel finish to be applied to guns? Any information you can forward on the matter will be greatly appreciated.

J. T. H.

**Answer:** The genuine blue color is a heat or temper color. Usually in "blueing" gun barrels, a caustic black finish is applied. We are enclosing herewith a list of suppliers of blackening salts as listed on pages 26 to 31 of our *Metal Finishing Buyer's Directory*.

## Finishing Stainless Steel

**Question:** We are manufacturing a line of cheese and pie knives of stainless steel and would like to have any available data on the methods of finishing this metal.

F. A. P.

**Answer:** If die marks are to be taken out, the first operation would be polishing with a compressed leather wheel set up with 180 emery and operated at 7,000 ft./minute. Grease should be applied to the wheel. The surface is cut down with an aluminum oxide buffering compound and then colored with a chrome coloring rouge at wheel speeds of 9,000 to 10,000 ft./minute. Suitable buffering and coloring materials are obtainable from your local suppliers.

## Finishing Aluminum

**Question:** We are trying to develop a finish on aluminum that will compare with oxidized silver. We have experimented with anodizing but the finish is too hard to cut through.

N. E. H.

**Answer:** We would suggest that you use the following solution at boiling temperature.

White arsenic 10 oz./gal.  
Soda ash 10 "

## Electrolytic Polishing

**Question:** Will you please send us all information concerning the electrolytic polishing of aluminum. How it withstands corrosion, etc.

We are very anxious to get this information so your earliest attention to this matter will be greatly appreciated.

R. J. C.

**Answer:** The process is intended

for producing a bright finish and not for corrosion resistance. A number of formulas for electropolishing aluminum will be found in an article by Otto Zmeskal which appeared on pages 280-286 of the July, 1945 issue of *Metal Finishing*.

## Gold Plating

**Question:** Will you please assist me on the following problem. I am job plating on silver costume jewelry. My gold plating doesn't seem to adhere. I get complaints that it rubs off within a week. My procedure is:

- 1—Electroclean
- 2—Rinse and dip in sulfuric acid solution
- 3—Cyanide dip
- 4—Copper flash
- 5—Brass flash
- 6—Gold plate 10-15 seconds

I do not lacquer the work. What should be the best procedure?

H. S.

**Answer:** Electrodeposited gold is too soft a metal to withstand wear even if the thickness is increased beyond the usual flash. We would suggest that a good wear resistant lacquer be applied after gold plating.

## Cracking of Nickel Deposits

**Question:** I am having trouble with heavy nickel valve pumps. These valves are in the cleaner 10 minutes, then bright dipped and brushed with pumice stone. They are then plated about 0.003" thick, then ground off about 0.001" so as to have a nickel bearing. I am having trouble with the nickel cracking and it flakes off in the grinding process. I am sending a valve and a sample of the solution. I would greatly appreciate any information that you could give me on it.

C. G. P.

**Answer:** The cracking is undoubtedly due to brittle nickel and would require correction of both your solution and operating conditions. We regret to advise that we do not analyze solutions for our subscribers.

but would suggest that you send your sample to one of the laboratories advertising in *Metal Finishing*.

#### Plating Baby Shoes

**Question:** Can you furnish us with a complete process for plating baby shoes. I would like to have the fastest and most up-to-date way so as to do them in quantities.

E. H.

**Answer:** Information on this process will be found in the book, "Metallizing Non-Conductors", by Samuel Wein which is available from this office at \$2.00 per copy, payable in advance.

#### Poor Adhesion

**Question:** We are having trouble in the process of nickel and chrome plating brass parts that have a small percentage of tin in them along with the 30% zinc and 70% copper.

The nickel looks good until the high amperage for chrome plating is used, then we get a series of small blisters on the nickel plate. We are of the opinion that the fault lies in the cleaning of the basis metal, and having tried most every way to clean them, we cannot get an adherent plate until we have scoured the brass by hand, causing the bright finish to disappear on the buffed brass and making it exceptionally hard to color the nickel deposit.

Our procedure is to wash the brass in trichlorethylene, soak in a recognized cleaner, rinse in water, dip in a 6 oz. solution of sodium cyanide, rinse in water, dip in a 10% solution of sulfuric acid, rinse and plate in nickel. We have no trouble in plating on copper that we have deposited on steel, and we have even tried copper plating the brass, but as you are aware this is not practical unless it is the only way out of our difficulties.

D. P. F.

**Answer:** The usual procedure is to copper flash in a hot cyanide copper solution before nickel plating in order to obtain good adhesion.

#### Plating Tank

**Question:** I have a new birch-wood tank which does not leak when filled with water. I would, however, like to use a warm nickel solution or a

bright nickel solution at pH 5.3-5.8, in this tank.

Can you tell me if the wood will ruin the solution, or, if the tank will be damaged? What lining or paint would you suggest I use to stand a temperature of 125° to 140° F.?

Would you please, also, send me any information you might have available on the latest formulas for bright nickel, brass and copper solutions?

M. K.

**Answer:** An unlined tank is not satisfactory for this purpose and we suggest that your wood tank be lined with plastic or rubber or preferably that you obtain a rubber-lined, steel tank.

Formulas for plating solutions will be found in the 1945 edition of the *Plating & Finishing Guidebook*, copies of which are obtainable from this office at one dollar each, payable in advance.

The hot bright nickel solutions are all patented and we would suggest that you communicate with one of the suppliers on the attached list from the *Metal Finishing Buyer's Directory*.

#### Tank for Nickel Plating

**Question:** Is a stainless steel tank suitable for nickel solution? Solution is of room temperature and pH is 5.2-5.8.

E. S.

**Answer:** A stainless steel tank is not suitable for nickel plating solutions.

Lead has been used but tends to give brittle nickel deposits. We would suggest that you use a non-metallic tank or lining for this purpose.

#### Producing Weathered Appearance

**Question:** Can you give us information on a method for producing an artificial patina (weathered appearance) on bronze memorial plaques?

C. R. M.

**Answer:** Brush on or stipple with the following solution:

Copper sulfate	1 lb.
Ammonium chloride	" "
Water	1 gal.

Formulas for producing various antique effects can be found in "Metal Coloring", by Hiorns, copies of which are probably available at the local library.

#### High Lustre Finish

**Question:** We are at the present time setting up to bring through our plant a large quantity of parts made from brass. Components will consist of the following 3 categories:

1. Brass castings
2. Turned parts from brass rod
3. Brass stampings from brass sheet

It is necessary for us to obtain a high polished finish on these parts. Will you kindly advise the best possible method to obtain these results either mechanically or chemically. We understand that there are certain solutions through which the parts can be run and which will obtain the high polished surface or assist in obtaining it and thus eliminate considerable labor. Any comments that you can give us along this line will be greatly appreciated. If there is any further information which you might require please do not hesitate to let us know.

I might mention further that we find your magazine of extreme interest and it is being circulated among a number of our staff.

C. O. D.

**Answer:** If the parts are small and do not nest, a good finish can be produced by ball burnishing. The most satisfactory method of producing a high luster on large parts is wheel polishing and buffing.

#### Blisters After Baking

**Question:** A part of the surface of this casting must have a chrome-plated finish and the remainder of the surface must have a painted finish (lacquer baked at 275° F.). The chrome plating is apparently sound; however, after the paint is applied and baked, the chrome plate develops numerous blisters.

We have heard that a normalizing after plating would correct this, but do not know what time or temperature to use. We would appreciate any light you might shed on this subject.

C. B.

**Answer:** The usual cause of this blistering is diffusion of the copper undercoat into the zinc which is quite rapid at elevated temperatures. Improper preparation of the zinc for plating may also be a cause. We would suggest that you apply a minimum of .0003 inches of copper followed by nickel and chromium. This thickness of copper deposit will be sufficient to permit baking without complete diffusion.

# THIS IS WASHINGTON -

By George W. Grupp

METAL FINISHING's Washington Correspondent



## Kreml Addresses Baltimore-Washington Branch

The April meeting of the Baltimore-Washington Branch of the American Electroplaters' Society, which was held in Baltimore, Md., was addressed by John Kreml, research chemist in charge of electrolytic polishing of stainless steel at the Rustless Iron and Steel Division of the American Rolling Mill Company of Baltimore, Md. After first delivering a brief history of electropolishing which aims "to produce a bright surface on" such metals as aluminum, copper, gold and stainless steel, he then discussed the acid solutions used, the current density and voltage, the equipment required, and the methods of preparing stainless steel for electropolishing. He stated that electropolishing, which has reduced many cleaning problems, "is the reverse of electroplating." He does not believe it will replace but merely supplement mechanical polishing. He pointed out that it increases corrosion resistance since it penetrates into cracks and small pits. The process will remove light scale from heated or annealed materials; and it will oxidize silver solder. In addition to that he pointed out the commercial uses of electropolishing, the problems of the process, and the new field of opportunity it is opening up for electroplaters. After completing his paper Mr. Kreml demonstrated with a small scale unit the process of electropolishing.

## Baltimore-Washington Branch Elects New Officers

The Baltimore-Washington Branch of the A. E. S. elected new officers for the year 1946-47 at their April meeting. The new officers are: President: Dr. Abner Brenner, electroplating research chemist, National Bureau of Standards, Washington, D. C.; Vice-President: Robert D. Guerke, Jr., plating superintendent, Koppers Company, Inc., Baltimore, Md.; Secretary-Treasurer: L. G. Tubbs, U. S. Navy Bureau of Aeronautics, Washington, D. C.; Librarian: Nathan E. Promisel, chief metallurgist, U. S. Navy Bureau of Aeronautics, Washington, D. C.

**Huston Thanks Officers** Retiring President Kenneth M. Huston and retiring Secretary-Treasurer Al G. Taylor of the Baltimore-Washington Branch gave the members a full and informative report of the activities and the accomplishments of the Branch during the past year. Before concluding his report, Kenneth M. Huston very graciously thanked all officers and committee-men for their splendid cooperation during his tenure of office. After that he recommended for consideration that all officers in the future should only serve one term in order that a greater number of the members can become familiar with the work of the Branch.

## Delegates to Convention Elected

Kenneth M. Huston, 3rd vice-president of the A. E. S., and research engineer of the Rustless Iron and Steel Company of Baltimore, Md.; Dr. Abner Brenner, president of the Baltimore-Washington Branch, and electroplating research chemist of the National Bureau of Standards, Washington, D. C., and Robert D. Guerke, Jr., vice-president of the Baltimore-Washington Branch, and plating superintendent of Koppers Company of Baltimore, Md. As alternate delegates the following were

elected: Thomas F. Slattery, assistant director, U. S. Bureau of Engraving and Printing, Washington, D. C.; Dr. Vernon Lamb, research chemist of the National Bureau of Standards, Washington, D. C., and Matthew J. Kraft, owner-manager of Kraft Quality Plating Company, Baltimore, Md.

## May Meeting of the Baltimore-Washington Branch

The May meeting of the Baltimore-Washington Branch will be an unusual affair for it will be addressed by five girl electroplating chemists on the staff of Dr. Abner Brenner of the National Bureau of Standards. Before the meeting the young women will serve dinner to the members in one of the Bureau buildings.

## Tubbs is Now With the Navy

L. G. Tubbs, who for some years was chemist at the Mutual Chemical Company of America, at Baltimore, Md., has resigned to accept a position as research chemist at the United States Navy Bureau of Aeronautics, Washington, D. C.

## Metal Finishing Orders in Effect

The following Civilian Production Administration orders are still in force: High Glue Stock Order M-390; Grain Alcohol Order L-353; Rosin Order M-387; Schedule E, Protective Coatings Glass Containers and Closure Order L-103; Uranium Order M-285; Scheduled Products Order M-293; Imports of Strategic Materials Order M-63; Lead Order M-38; Tin Order M-43; Cans Order M-81; Antimony Order M-112; Tin-plate Scrap Order M-325, and Cadmium Order M-389.

## CPA Priorities Regulation 28 Has Been Amended

The CPA Priorities Regulation 28 was amended to rearrange and clarify the priorities regulation under which bottleneck-breaking CC ratings are issued. The amended regulation states that "the 'minimum economic rate' of operations means the rate of operation at which the plant as a whole must operate to avoid incurring a financial loss, without regard to any particular product if the plant makes more than one. If a plant is currently operating at less than capacity without incurring a financial loss, the minimum economic rate of operation will not be considered a higher rate than the current one, even though some of the plant's regular products are not currently being produced."

## Buy Surplus Equipment from an "Approved Dealer"

Electroplaters who wish to buy surplus equipment for their plants should contact the regional office of the War Assets Administration for the purpose of securing from them the list of the names and addresses of "approved dealers." On March 31, 1946, there were 1,574 such dealers, and hundreds of others are in the process of being approved.

## OPA Has Become a Problem

At this writing the outlook of the Office of Price Administration is rather dark. President Truman received one of the worst reverses when the House passed a bill which Price Administrator Paul A. Porter avers would doom price control. The tacking onto the bill of the Gossett De-control Amendment and the Wolcott-Andersen cost-plus-a-

reasonable profit Amendment has set some of the OPA officials to pulling the hair out of their heads. Some feel that the relaxing of price control would cause inflation and give labor reasons for making additional demands. Others think it would stimulate production, and end the withholding of goods. And then there are some who think this is one way of telling President Truman and Commerce Secretary Wallace that Congress does not intend to be regimented by the White House as to what it should think and do.

**36,301,000 Man-Days Lost During War Due to Strikes** The Department of Labor announced on April 19, 1946, that during the period January 1, 1945, to August 14, 1945, there were a total of 2,971 stoppages of work involving 1,791,000 workers which cost the workers 9,593,000 man-days of time. It also revealed that during the period December 8, 1941, through August 14, 1945, the duration of war, there were a total of 14,731 work stoppages involving 6,744,000 workers and resulting in a loss of 36,301,000 man-days.

**Government Plans to Import 78,000 Tons of Lead** To help overcome the current shortage of lead the Government plans to import about 78,000 tons of lead during the second quarter of 1946.

This compares with the importation of 32,500 tons during the first quarter.

**Senate Plans Strict Curb on Labor** The United States Senate is planning to put some teeth into the Case labor bill. The bill will bear little resemblance to the labor curb bill as passed by the House.

**Treasury Silver is Needed to Meet 1946 Needs** It is the opinion of experts that the unavailability of United States Treasury silver may curtail the production of silver using industries. It is estimated that the requirements for 1946 amount to 125,000,000 ounces of silver of which 70,000,000 ounces is needed by the silverware industry; 12,000,000 ounces by the jewelry industry; 1,000,000 ounces by the engine bearing industry; 10,500,000 ounces by the brazing alloy industry, and 10,000,000 ounces by the electrical contact industry.

**Increased Copper Costs Must Be Made Up in Prices** Chester Bowles, Director of Economic Stabilization, announced on April 18, 1946, that all increased costs to copper producers due to wage increases, now under consideration, will not be reimbursed by subsidy payments but by price increases.

**65 Cents Wage Rate Bill Passed by Senate** The Senate passed a bill on April 5, 1946, which provides for an hourly minimum wage of 65 cents per hour. Eight amendments were added to the original bill. What will happen to the bill before it is finally passed by both houses of Congress is still any man's guess.

**Salary Regulations Clarified by Treasury Department** During the past month Commissioner of the Internal Revenue Joseph D. Nunan, Jr., issued a regulation which gives employers the right to fix salaries as they see fit provided their products or services are no longer controlled by OPA price ceilings, or for which no price ceiling increases are to be applied for. But it should be remembered that unlawful salaries, the regulation provides, are those established in a new plant or department of an existing business at rates in excess of those prevailing in the particular industry or area and not approved by the Salary Stabilization Unit of the Treasury Department.

**Here is What the AFL Thinks of the New Wage-Price Policy** The April number of the AFL's *Labor's Monthly Survey*, makes this observation: "The vast majority of American workers receive a serious set back under the new wage-price policy. Before February 14,

workers could make a real gain in living standards by getting an increase of 10 cents because price ceilings were held, . . . But now workers must get 18½ cents to have a real gain of 8½ cents. The 18½ cents look large, but the real gain is less than before. . . . We all know that real gains in living standards can only come by increasing production per man-hour and turning out more food, clothes, housing, autos, etc., for everyone. This requires the joint effort of workers and employers. The new policy however deceives some workers by making them think they can advance by government handouts. It opens genuine unions to attack by subversive elements who can raid them with the slogan: 'Join us and get 18½ cents.' It favors powerful employer groups against small business because the former can bargain with the government for prices as the steel employers did. Could the results be more subversive to free enterprise and free unions? All this destroys the joint effort to improve production which alone can bring progress."

**Decontrolled Equipment Prices May Rise 10 Per Cent** According to some experts the Office of Price Administration's decontrolling of equipment prices is not expected to cause a rise of prices in excess of 10 to 15 per cent. In fact some machinery equipment is not expected to rise at all.

**WSB Renders Important Decision** The National Wage Stabilization Board rendered an important decision, which will affect other cases, when it refused to approve an 18 cents an hour wage increase to the members of the CIO United Dairy Workers because it felt that such increase is not necessary in order to relieve any inequity between related industries.

**War Contract Settlements to Be Speeded Up** In an effort to speed up the settlement of millions of dollars of war contracts the Office of Contract Settlement has issued Rule 21 which requires Government contracting agencies to respond to claims within a brief period of time. It also protects private contractors who file their claims with the wrong Federal agency.

**Pricing Procedure of Machinery Revised** The Office of Price Administration revised MPR-136 on April 13, 1946, for the purpose of adapting the regulation to the needs of manufacturers of machinery and parts in the industrial changeover to peacetime production. The regulation makes the establishment of a price ceiling a little more flexible. Manufacturers of electroplating equipment should receive some relief from this revised regulation.

**OPA Removes Many Price Ceilings** On April 9, 1946, the Office of Price Administration suspended price control over hundreds of items, especially in the consumer goods category. And there was liberal decontrolling of price ceilings on quite a few capital goods items—"capital goods which do not affect significantly either the cost of living or business costs." Price Administrator Paul A. Porter said that most of the items suspended are "commodities in which demand and supply or potential supply are in sufficient balance now that prices will not rise unduly above existing ceilings or levels to which they would be raised in conformity with the agency's standards."

**Brass Products Price Ceilings Raised** The Office of Price Administration increased the price ceiling on brass mill products about 1.5 cents a pound on April 1, 1946.

**Lead Allocations Reduced** The Civilian Production Administration on April 2, 1946, reduced the lead allocations for the second quarter of 1946 by about 10 per cent. Permissive inventories of lead have been reduced from 45 days' supply to 30 days' supply. In addition to amending Lead Order M-38, the CPA issued a new lead chemical Order L-354 which restricts the amount of lead which may be used in lead chemicals.

### Copper Prices Expected to Rise

The price of domestic copper is expected to go up because of the dropping off in world production, strikes, and the rising prices of foreign copper.

### New Packing Charges On Slab Zinc

April 17, 1946, to provide for a new schedule of special packing and loading charges which may be added to the ceiling prices of primary slab zinc. The amendment permits an extra 30 cents a ton charge on slab zinc wired or strapped; 50 cents a ton charge on slab zinc wired or strapped on wooden pallets, and 70 cents a ton on slab zinc wired or strapped on steel pallets,

### Lead Producers Asked to Ration Their Distribution

Lead producers and smelters have been asked by the Civilian Production Administration to adopt a voluntary rationing system to spread with equity the available supply of lead.

### Copper Production Falls

1946 as compared with 58,178 tons in January.

### Copper Inventories May Be Tightened

The Civilian Production Administration may tighten control over copper if the strikes continue to upset the balancing of the supply with the demand. In fact inventory restrictions under PR-32 are expected to be reduced from 30 days to 20 days.

### Pig Tin Quota Has Not Improved

of 1946 will be about the same as that of the first quarter of this year, according to the Civilian Production Administration. Amended Conservation Order M-43, which established the quota for the second quarter, in Schedules II and VI, provides that terne metal (the coating on blackplate) may now be made from either pig tin or secondary tin.

### Silver Export Tax Removed by Mexico

The Mexican Government removed the export tax of 3.23 cents an ounce on silver on April 4, 1946. The removal of this tax is expected to yield an additional profit of \$2,000,000 to nine different silver mines in Mexico.

### New Zinc Slab Ceiling Established

secondary "high grade" metal. Amendment No. 2 to MPR-3.

### Slab Zinc Production is Increasing

The American Zinc Institute reports that the production of slab zinc for March, 1946, amounted to 71,612 tons as compared with 61,274 tons in February, 1946.

### Brazil Has Huge Nickel Deposits

Ministry of Agriculture reveals that there are large quantities of nickel in the State of Goiaz. An examination of an area of 36 square miles in the Mantiqueira district resulted in locating 45 deposits which contain large amounts of nickel bearing garnierite.

### Higher Wages Without Price Increases

In the current issue of the Department of Commerce's *Survey of Current Business*, the Commerce Department continues to hold to its theory that industry generally can pay higher wages out of profits without increasing its prices.

### War Department Plans New Cost Plus Fee Contract

A new procurement bill is being prepared by the War Department which will establish a cost-plus-fixed-fee contract with a 10 per cent fee for ordinary work, and a 15 per cent fee for research work.

### Shipments of Porcelain Enamel Products Increasing

The Bureau of Census of the Department of Commerce reports that during the first two months of 1946 the value of shipments of porcelain enameled products amounted to \$9,373,087 as compared with \$5,772,154 for the same period in 1945, and with \$5,310,358 in 1944.

### High Temperature Ceramic Coatings May Now Be Released

During the war the compositions and technique of application of the Bureau of Standard's ceramic coatings were held in a confidential status, except to those companies engaged in war work where this information was essential. Now that the war is over several manufacturers have made inquiries for the purpose of making use of these coatings on peacetime products such as selected parts of stoves and kitchen ranges.

### Production of Chemicals in February

The Bureau of Census of the Department of Commerce reports that during the month of February, 1946, there was produced 39,738 short tons of synthetic anhydrous ammonia; 38,543 short tons of ammonium nitrate; 17,855,000 pounds of synthetic ammonium sulfate; 84,798 short tons of chlorine; 4,140,000 pounds of chrome yellow and orange; 26,837 short tons of hydrochloric acid; 3,063 hydrofluoric acid; 185,000 gallons of methanol; 31,121 short tons of nitric acid; 69,728 short tons of phosphoric acid; 649,432 short tons of soda ash; 175,719 short tons of sodium hydroxide; 62,837 short tons of sodium sulfates, and 1,721,471 short tons of sulfuric acid.

### Electric Motors and Generators on Adjustable Pricing Basis

Orders 599 and 600 under RMPR 136, issued on April 11, 1946, points out that manufacturers of fractional horsepower electric motors and of integral electric horsepower motors and generators are now permitted to sell such equipment at adjustable pricing bases. In other words, the motors and generators may be sold at present ceiling prices with an agreement with the buyers that they will pay the difference between current ceiling prices and any higher prices which may be fixed by OPA.

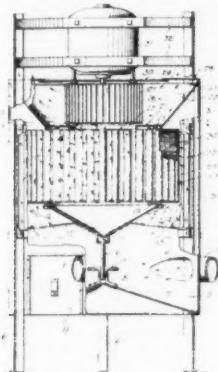
### Postwar Aluminum Consumption

In the April number of the Department of Commerce's *Domestic Commerce*, Daisy L. Schooley of the Machinery and Metals Division, in an article on "Peace Demands for Aluminum Expand" it is brought out that aluminum is now put to 3,500 uses as compared with 1,500 during the pre-war days. The author estimates that in the postwar period 34 per cent of the total consumption of aluminum will be consumed by the transportation industry; 10 per cent by the cooking utensils industry; 8 per cent electrical conductor industry; 12 per cent by the machinery and electrical appliances industry; 9 per cent by the building construction industry; 5 per cent by the chemical industry; 9 per cent by the foundry and metal working industry; 4 per cent by the ferrous and non-ferrous metallurgical industry; 5 per cent by the food and beverage industry, and 4 per cent for miscellaneous industries.

## Patents

### Dust Collector

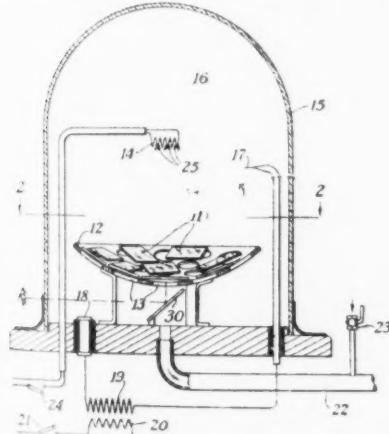
U. S. Pat. 2,394,923. W. P. Little, Feb. 12, 1946. In a dust collector and separator, an upright casing, a bottom diffusing cone and an inverted cone of less diameter than the casing spaced above the first cone forming a centrifugal separating chamber, a



tangential inlet for dust laden air to said chamber, a hollow filter located above the second cone to receive the air passing upwardly around the periphery of this cone, an inverted cone above the filter forming a diffusing chamber open through its top wall for discharge of air, and a fan located in this latter chamber with its inlet connected with the outlet of the filter and discharging laterally into said diffusing chamber.

### Thermal Evaporation

U. S. Pat. 2,394,930. D. B. McRae, assignor to Eastman Kodak Co., Feb. 12, 1946. The method of forming a reflective coating on a surface of a glass base comprising initially cleaning the surface to be coated, placing the base in a chamber, evacuating



said chamber, depositing by thermal evaporation a layer of aluminum upon said surface while in said vacuum, breaking said vacuum to allow the air to contact said layer, removing said base from said chamber, hardening and toughening said oxidized layer by burnishing with cold water and rubbing with a cloth, replacing said surface in said chamber, reforming said vacuum,

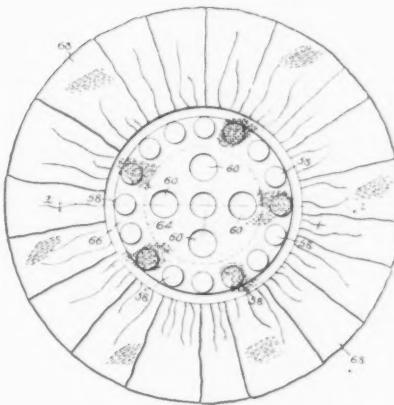
depositing by thermal evaporation a layer of aluminum upon said oxidized layer, breaking the vacuum to allow the air to contact said second deposited layer to oxidize the latter, and then hardening and toughening said second oxidized layer by burnishing with cold water and rubbing with a cloth.

### Hot Tinning

U. S. Pat. 2,394,545. W. F. Grupe, assignor to Interchemical Corp., Feb. 12, 1946. The method of producing tin plate tinned in predetermined areas only, which comprises applying to a base plate in predetermined areas a flux which loses its fluxing properties on heating at the temperature of the tinning bath in which the base plate is to be tinned, passing the fluxed base plate into a bath of molten tin at a point between the oxide dross level and the tin-iron alloy dross level, passing the plate upwardly through the bath and wiping excess tin and dross from the plate as it emerges from the bath to produce a plate tinned only in the areas to which the flux is applied.

### Abrading Wheel

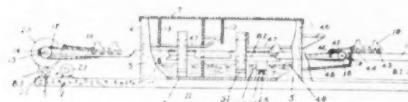
U. S. Pat. 2,395,325. E. W. Hall, Feb. 19, 1946. A rotary abrading tool comprising an



arranged to introduce air pressure into the cylinder from the supply conduit ahead of the valve, said air being introduced into the cylinder on the side of the piston to tend to cause movement thereof in a valve opening direction, there being a bleed passage through the piston from said one side thereof to the other, a spring normally urging the piston in a valve closing direction, and a hand valve arranged to vent air pressure from the cylinder on said other side of the piston, the venting valve having a greater capacity than said bleed passage.

#### Cleaning Machine

*U. S. Pat. 2,395,160.* C. H. Anderson, Feb. 19, 1946. A cleaning and scouring machine including a tank to contain a fluid mixture of water or other suitable liquid and sand



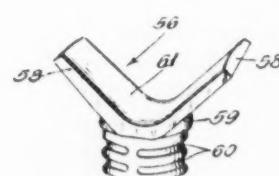
or other abrasive material, supports mounted in the tank to support the parts to be cleaned, a manifold surrounding the supports inside of the tank arranged to conduct the fluid abrasive mixture under high pressure to jets or outlets formed in the manifold through which the mixture may be forcibly sprayed upon and against the parts to be cleaned, and means to supply the manifold with the fluid mixture under high pressure.

#### Pickling Inhibitor

*U. S. Pat. 2,394,773.* W. H. Hill, assignor to American Cyanamid Co., Feb. 12, 1946. An inhibitor composition for pickling ferrous metals comprising a non-oxidizing pickling acid solution and a condensation product of formaldehyde with the reaction product of hydrogen sulfide and a melamine.

#### Bus Bar Support

*U. S. Pat. 2,396,131.* W. M. Scott, Jr., assignor to I. T. E. Circuit Breaker Co., Mar. 5, 1946. In combination, a bus bar, a supporting structure therefor, an insulator interposed between said structure and bus bar for maintaining said bus bar in spaced relation with respect to said structure, means for pivotally supporting one end of said in-



sulator to said housing to permit said insulator to be rocked about a predetermined center, and insulator supporting means secured to the other end of said insulator, said supporting means being in tangential engagement with the bus bar, whereby as the bus bar moves axially, the insulator rocks on its pivoted support as said insulator supporting means maintains tangential connection with the bus bar.

#### Oxide Removal

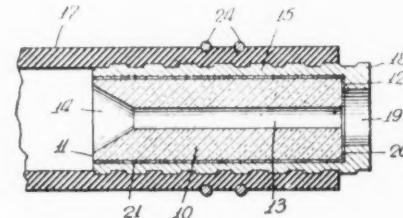
*U. S. Pat. 2,395,694.* H. R. Spence & H. W. Hooker, assignors to Hooker Electrochemical Co., Feb. 26, 1946. The method of removing from the surface of metals resistant to fused caustic alkalies dense firmly adherent oxide that has formed thereon through exposure to air under oxidizing conditions which comprises subjecting the oxide to the action of a fused substantially anhydrous bath comprising caustic alkali containing a substantial but minor proportion of an oxidizing agent stable therewith, said bath being maintained at an oxidizing potential with respect to the metal, at a temperature of 300° to 600° C., for not less than 1 minute, and then subjecting the oxide to the action of a weak inorganic acid.

#### Coloring Stainless Steel

*U. S. Pat. 2,394,899.* I. C. Clingan, assignor, by mesne assignments, to The American Rolling Mill Co., Feb. 12, 1946. The art of blackening stainless steel articles and products which includes, treating the stainless steel articles or products by immersing the same in a molten salt bath consisting essentially of sodium dichromate and potassium dichromate, the while holding said bath at a temperature in the range of 400° C. to 500° C.

#### Sandblast Nozzle

*U. S. Pat. 2,395,479.* J. A. Heany, assignor to Heany Industrial Ceramic Corp., Feb. 26,



1946. A sand blast nozzle comprising a nozzle tube having a central duct terminating in a flared inlet orifice, a casing enclosing the side and a portion of one end of the tube, and a protective sheath covering substantially the entire side area of said casing, said sheath forming a uniform, continuous extension of the nozzle supply conduit.

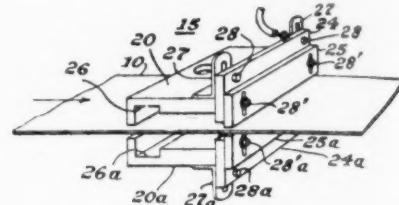
#### Pickling Inhibitor

*U. S. Pat. 2,394,774.* W. H. Hill, assignor to American Cyanamid Co., Feb. 12, 1946. An inhibitor composition for pickling ferrous metals comprising a non-oxidizing pickling acid solution and a condensation product of formaldehyde with the reaction product of hydrogen sulfide and a substance chosen from the group consisting of diethylene triamine, triethylene tetramine and triethylamine.

#### Treating Sheet Metal

*U. S. Pat. 2,395,437.* W. M. Venable, assignor to Blaw-Knox Co., Feb. 26, 1946. Apparatus for the electrolytic treatment of a rapidly moving strip of metal comprising means for rapidly moving the strip under tension longitudinally with its transverse axis horizontal, a succession of horizontal

baffle means along the path of travel of the strip on each side thereof and spaced close to but out of contact with the strip, said baffle means being of a length at least coextensive with the full width of the strip, a housing surrounding the strip adjacent each baffle means, said housings being spaced apart to provide openings at the lateral side edges of the strip, means in advance of each baffle means for supplying electrolyte to the housings to be carried by the strip toward and beyond the baffle means, said means for supplying electrolyte operating to supply the electrolyte at a rate faster than said elec-



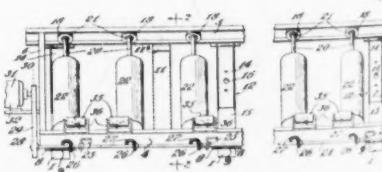
trolyte can be carried under the baffle means whereby a turbulent pool of excess electrolyte is established and maintained in the housings across the leading face of each of the baffle means and excess electrolyte is flowed sideways beyond the edges of the strip, means electrically connecting said baffle means to a source of current whereby electrolytic action is concentrated in the liquid adjacent the baffle means.

#### Phosphate Coating

*U. S. Pat. 2,394,065.* G. W. Jernstedt & J. C. Lum, assignors to Westinghouse Electric Corp., Feb. 5, 1946. The method of prolonging the active life of an aqueous solution comprising essentially an acid phosphate for producing a protective phosphate coating on zinc, cadmium and their alloys which comprises maintaining free ferrous metal in a form having an extensive surface in contact with the solution thereby maintaining from 0.10% and higher of dissolved iron in the solution while being applied to said metals.

#### Drum Cleaning Machine

*U. S. Pat. 2,395,593.* J. Trager, Feb. 26, 1946. A drum-cleaning machine comprising a frame member adapted to be supported at an inclined angle relative to the horizontal,



a pair of spaced drum-driving rollers having their end portions rotatably mounted on opposite sides of the frame so as rotatably to support a drum, driving means for rotating at least one of said drum-driving rollers, and a guide roll mounted adjacent to the lower end of each drum-driving roller with its axis in the plane which is at approximately right angles to the axis of the adjacent drum driving roller so as to engage the lower end of a drum supported thereon.

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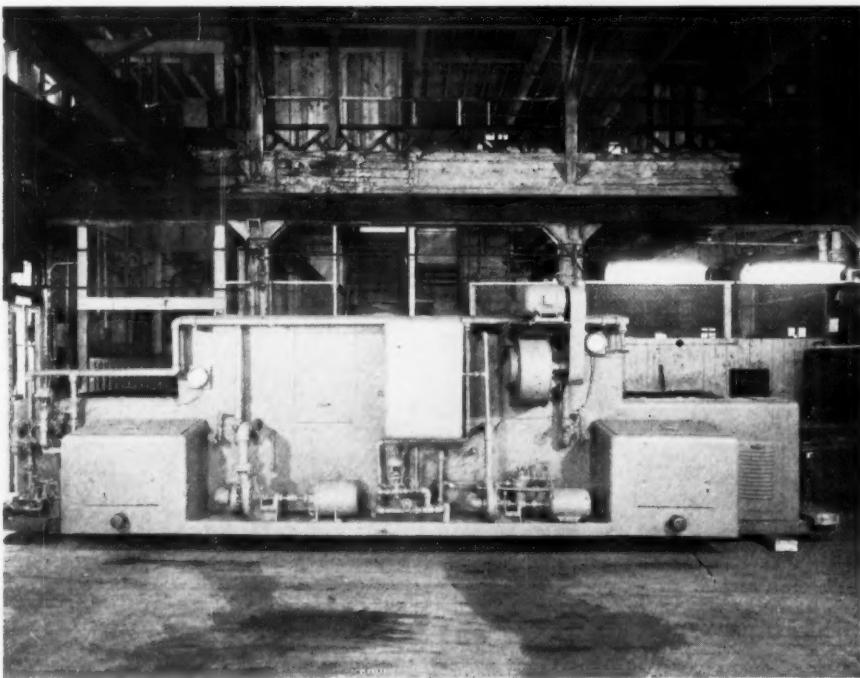
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# NEW EQUIPMENT AND SUPPLIES

NEW PROCESSES, MATERIALS AND EQUIPMENT FOR THE METAL INDUSTRY



## Cleaning Machine

The Howard Engineering & Mfg. Co., Dept. MF, 2290 Buck St., Cincinnati 14, Ohio, is the producer of a new type cleaning machine, which was developed to solve one of the conversion problems of a leading automotive manufacturer.

In using one of the processes developed in war-time manufacturing, the automotive plant found that they could substitute a stamped and welded tube for the conventional cast and machined rear axle housing, with substantial savings in materials and machining costs.

In practice, however, it was found that when the two formed halves of the housing were seam-welded together, a loose scale formed on the interior of the housing near the welds. It was feared that this scale would eventually flake off and mix with the differential gear lubricant to form an abrasive that would harm the gears.

Howard engineers found that even high pressure sprays would not remove the scale and turned to a mechanical method of removal. This machine that was developed conveys the axle housing through on a conveyor belt, with an indexing arrangement that stops the housing at one station where a revolving steel brush enters the housing to brush loose the scale. At the same time cleaning solution is fed through and around the brush as well as on the exterior of the axle, flushing away the scale and other foreign matter. At the sec-

ond station, the housing is dried with hot air.

The conveyor belt of the machine incorporates fixtures that hold each axle housing in the correct position during both the brushing and drying operation. Operation of the brush into and out of the housing is accomplished by an air cylinder operated in conjunction with the indexing of the belt.

The machine is furnished completely piped for steam, air, water supply and drainage. Connection of the four services and electrical power complete installation of the machine in the plant.

## New Process for Plating Aluminum

Krome-Alume, Inc., Dept. MF, Lockport, N. Y., original licensors of the Travers process for plating aluminum and its alloys announces that it is no longer interested in this plating procedure and has completely abandoned it in favor of a new process developed by the corporation which is felt to be a vast improvement over the old procedure. Whereas the old method requires from 12 to 18 minutes of pre-plating treatment, the new process, a total departure from the old one, requires only 2 minutes of pre-plating treatment. Immersion in any plating bath regardless of its composition, acid or alkaline may be accomplished. In the case of nickel, a direct

deposit is applied, a flash of copper being unnecessary. Aside from the cleaning cycle which follows along normal lines, only one chemical solution is used in making the aluminum article available for plating. This is simple, inexpensive and will last for a considerable length of time.

The new method of plating, which will be introduced to the trade in the coming months, is especially adaptable to the plating of the dural alloys which always give trouble where anodizing precedes plating.

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BUSINESSES

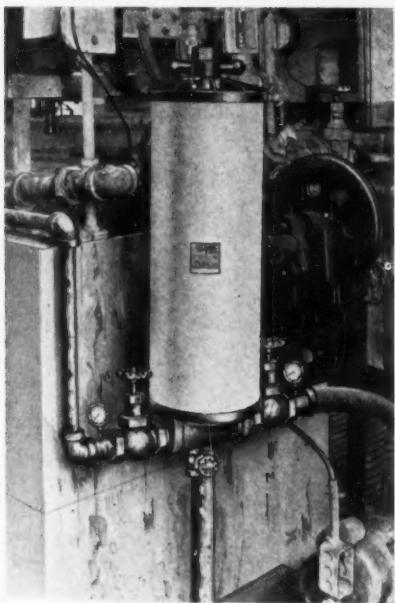
the reason apparently being that the plating requires a homogeneous anodic coating which is impossible where so many other metals are present. Adhesion produced by the new method is as good on any one of the durals as it is on the 2S or 3S, the purer forms of aluminum.

The new procedure consists of anodizing with 6 volts d.c. in a special compounded solution. This is done for 1½ to 2 minutes and is followed by rinsing and immediate plating, no modification of the anodic film, as in the case of the old procedure, being necessary.

It is believed by Krome-Alume, Inc. that this is the first time an anodic film has been developed over which a direct deposit of nickel, copper, cadmium or any other platable metal can be placed. The old Fisher patent plated direct over anodic coatings but only from copper flash baths, the cyanide acting as a modification agent for the anodic surface. Direct plating of nickel after anodizing was impossible with this method.

#### Continuous Filters

Fulfilo Filters, incorporating honeycomb filter tubes of unique construction, are now available for continuous filtration of electro-plating solutions. These filter tubes are made by winding a soft but strong yarn spun of long-staple cotton onto a wire screen core so as to form a honeycomb pattern of diamond shaped filtering tunnels. The tubes are supplied in units 8 to 10 inches long and 2½ inches in diameter for convenient replacement.



Due to the large capacity of the specially designed filter tubes, the containers for Fulfilo Filters are small and compact. For example a 12-tube unit, no larger than an umbrella stand, will filter the entire contents of a 1000-gallon plating every hour during continuous operations. The unit is small enough to be directly connected to the tank along with an individual motor and pump.

Using ordinary cyanide solutions such filters operate continuously as long as six

# Better cleaning of metal parts thru MECHANIZED HANDLING



In your plans covering the production or maintenance cleaning of metal parts, a new complete line of OPTIMUS EQUIPMENT units offer your plant operating men a number of outstanding advantages.

These new OPTIMUS machines enable the combining of operations in one nearby sequence, they assist you in obtaining the best control of quality in your metal cleaning and allied process operations. "Rejects" can be lowered, bottlenecks eliminated, production speeded up, with their use.

If you are crowded for space, if you

need to cut labor costs, eliminate needless "toting" of your metal parts — an OPTIMUS Plan for the mechanized handling of your metal parts through washing, rinsing and drying, can help you.

#### SEND FOR NEW ILLUSTRATED BULLETIN

An illustrated bulletin describing these new OPTIMUS Machines for metal parts cleaning is now in preparation, and will be sent to manufacturers interested in better handling of their parts cleaning operations. If you would like to receive a copy of the bulletin when it is ready, simply fill out and mail the coupon today.

#### OPTIMUS EQUIPMENT COMPANY

ENGINEERS AND MANUFACTURERS

127 CHURCH STREET, MATAWAN, N. J.

STANDARD AND SPECIAL TYPES OF EQUIPMENT  
FROM THE SMALLEST TO THE LARGEST SIZES  
FOR A WIDE VARIETY OF OPERATIONS.

**OPTIMUS**  **EQUIPMENT**

FOR WASHING • RINSING • PICKLING AND DRYING OF METAL PARTS

OPTIMUS EQUIPMENT COMPANY, 127 Church Street, Matawan, N. J.

Please send me a copy of your new Bulletin "Cleaning Metal Parts Before and After Finishing".

Name..... Position.....

Company.....

Company Address.....

City..... State.....

Mail this coupon with your company letterhead

## Ingenious New Technical Methods To Help You with Your Reconversion Problems



### New Portable Grinder Lasts Longer ...Increases Production

The Portable Gaston Grinder is designed for the grinding and sanding of metal—also, with wire brushes, for paint and rust removal. Because it is powered by a 3-phase motor, without brushes, commutators or gears, the Gaston will give long service.

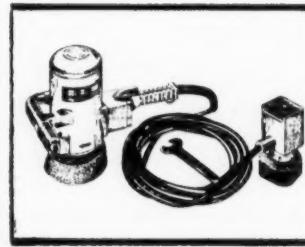
The Gaston Grinder starts at full speed. Its speed remains constant regardless of extra pressure by the operator. This controlled speed under heavy load, eliminates glazing of the grinding wheel; produces a better ground surface.

Three sizes of dust-tight Gaston Grinders are available. Furnished in either "cup-wheel" or "edge-wheel" type, as desired.

In a dusty work atmosphere, that causes throat irritation and dryness, chewing Wrigley's Spearmint Gum helps keep workers' mouths moist and fresh—thereby reducing work interruptions—and "time out" to the drinking fountain.

Workers can stay at their machine, while chewing Wrigley's Spearmint—even when their hands are busy. There is no lost time. And the pleasant chewing helps keep them alert and wide-awake. One Connecticut manufacturer, with a dust problem reports group production up about 3% over normal, when workers were given chewing gum. Other plants and factories everywhere, claim stepped-up efficiency when chewing gum is made available to all.

You can get complete information from William H. Howland  
2533 East 73rd Street, Chicago 49, Illinois



The Portable Gaston Grinder



AA-68

to eight weeks before requiring a change of filter tubes. Filter tubes can be readily changed without interrupting production.

The Commercial Filters Corporation, Dept. MF, 19 West Third Street, Boston, Mass., is the manufacturer of these filters, which are more fully described in their Bulletin No. 1000 B-2.

#### New Decarbonizing Cleaner

Now available to civilian users, Magnus 755 metal parts cleaner, made by Magnus Chemical Co., Inc., Garwood, N. J., represents one of the many advances in industry born of war urgency. When the Army Air Force needed a fast, effective compound for the difficult job of cleaning combat air-

craft engine parts during reconditioning, Magnus Research Laboratory developed this cleaner.

The new product is claimed to have been successfully used in removing gums, sludge and engine varnish without slowing down engine overhaul. When experimental work began, the Army Air Force cleaning cycle on engine parts was 4 hours. Magnus 755 is claimed to have cut this down to 1 hour per engine.

This parts cleaner is now being introduced to other industries for effectively removing accumulated deposits of carbonized oil, grease and dirt from metal parts. The rapid, penetrating action of the cleaner is claimed to make it a time-and-labor saver



in cleaning all carbonized, dirty and gummy parts.

For ordinary work, Magnus 755, used at room temperature, will provide rapid "de-greasing" action. Cleaning can be speeded, however, by heating the solution to 150° F. (in no case over 160° F.).

Despite its powerful cleaning ability, Magnus 755 is safe for use on any kind of metal. It will not attack aluminum alloys, babbitt bearing metal, solder or any other soft metals. Fire hazard is practically eliminated. Magnus 755 is non-corrosive to metals and will not injure leather or fiber gaskets.

Also used as a paint stripper, the cleaner removes coatings of paint, enamel and lacquer down to bare metal.

To cut down evaporation and dragout, the user adds a water seal of 25% by volume (1 gallon of water to 4 gallons of Magnus 755). Parts are soaked in this solution until deposits have been penetrated. They are then pressure spray rinsed with water or rinsed in safety solvent where use of water on the part is not desired.

Rubber fixtures should be removed before parts are immersed in the cleaner. Contact with the skin should be avoided. Workers doing the cleaning should wear rubber gloves as the solution reacts quickly with the natural oils of the skin, leaving it in a dry, chapped condition. Splashes on clothing or skin should be rinsed with plenty of water.

To make it economically available to small plants, Magnus 755 is optionally obtainable in a handy dip-tank container. The unit consists of 4 gallons of Magnus 755 in a 5-gallon container (to allow addition of the water seal), and a sturdy, welded parts dipping basket (see illustration).

For further information on this remarkable cleaner, write to Magnus Chemical Co., Inc., Dept. MF, Garwood, N. J.

#### Electric Hoist

Lisbon Hoist & Crane Co., Dept. MF, Lisbon, Ohio (successors to The Wright

File Co.) are now introducing their Bob Cat Model of Electric Hoists.

It is claimed to be of revolutionizing design—half the weight of any other first class hoist on the market of same capacity, which, it is claimed, makes it convenient in erecting or removing where desired.

It is one of the smallest in overall dimensions of any standard hoist—is made in practically three sections, permitting complete and easy access to any part by the removal of about four bolts.

It has a safety factor, it is claimed, of six to one and better. Made entirely of steel forgings and castings, plus the cable.

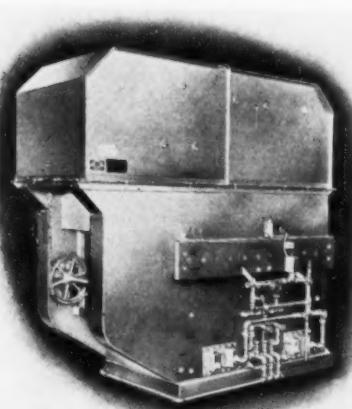
Motor is entirely enclosed in drum, with patented heat dissipation construction and connection. Ball bearing throughout. Gears are all heat treated alloy steel.

The light weight and small size has been made possible by the very unique engineering employed in the internal mechanism—the entire inside construction being very different from usual standard practice.

#### Vapor Degreaser

Small basketed parts are cleaned in a new two-dip immersion vapor degreaser recently added to Detrex Corporation's line of standard metal cleaning equipment. Designated a 500-C-1, the conveyorized machine permits a choice of any one of several cleaning cycles.

The 500-C-1 is fabricated from 10-gauge steel plate, reinforced with structural steel of all-welded construction. A water jacket condenser, tested for a working pressure



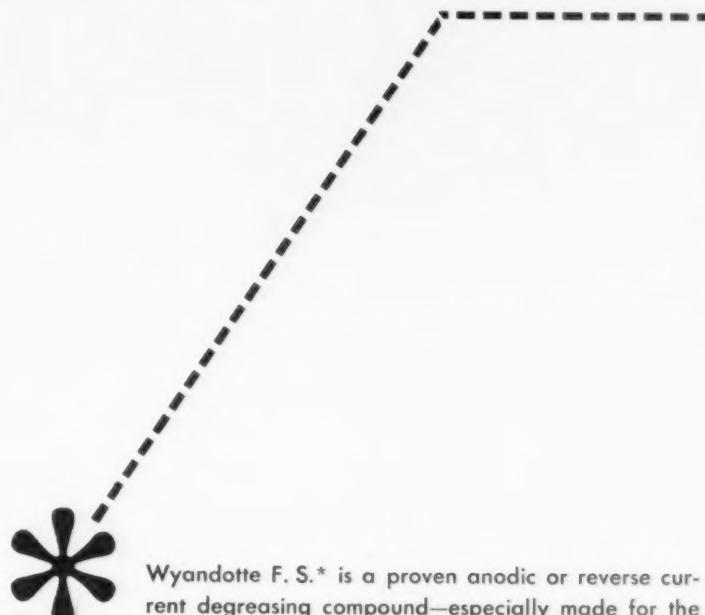
of 40 lbs. per sq. in., completely circles the machine. Beneath the condenser is a clean solvent collecting trough which carries the reclaimed solvent through a water separator to either the storage tank or the second chamber.

Work to be cleaned is loaded at one end of the degreaser, carried through the cleaning cycle, returned through the upper hood to the same end of the machine for unloading. The conveyor system is complete with the necessary sprockets, shafts, take-up device, speed reducer and vari-speed drive. All of the sprockets below the vapor line are zinc plated as are all of the cross rods and all of the conveyor chain.

The complete line of 500-C-1 vapor degreasers, which have hourly work load capacities of 2000 to 4000 lbs., incorporate eight different sizes of baskets ranging in size from 8" x 18" x 6" to

## For faster positive cleaning

### of ferrous metals—WYANDOTTE F. S.



Wyandotte F. S.\* is a proven anodic or reverse current degreasing compound—especially made for the complete removal of "smut" and fabricating compounds prior to plating. It produces a chemically clean surface that insures a uniform, more durable electro deposit.

This balanced formulation helped speed war production. Now it's facilitating reconversion to civilian manufacture—saving time . . . conserving material . . . reducing costs.

Wyandotte F. S. offers fast and complete wetting action . . . superior "smut" removal qualities . . . high conductivity, assuring quick and efficient removal of fabricating compounds . . . controlled foaming . . . long life in solution.

For more information about Wyandotte F. S., call your Wyandotte Representative. He's waiting to show you how this and other Wyandotte Metal Cleaners can work to your complete satisfaction.

\* Registered trade-mark

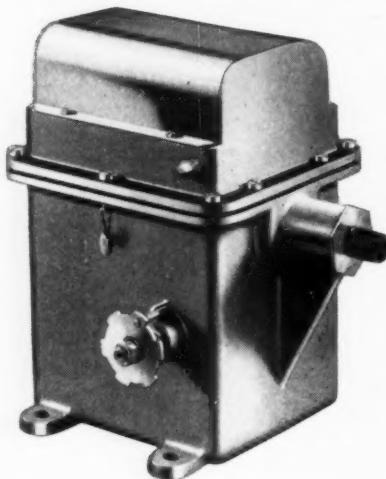


**Wyandotte**

REG. U. S. PAT. OFF.

WYANDOTTE CHEMICALS CORPORATION • J. B. Ford Division  
Wyandotte, Michigan • Service Representatives in 88 Cities

**BARBER-COLMAN**  
**ELECTRIC CONTROL MOTORS**  
**FOR 2-POSITION, FLOATING, and PROPORTIONING CONTROL**



TYPE EYCC  
 CONTROL MOTOR

**MANY APPLICATIONS.** These self-contained power packages are ideal for any control unit requiring a high torque *adjustable speed* motor and gear reduction with built-in limit switches. For instance — to regulate dampers in heating, ventilating, drying, cooling, or air conditioning systems — to operate butterfly valves, blast gates, and the like — to operate air and gas mixing valves, multiple ratio fuel valves, and industrial fuel carburetors. They are also suitable for driving program switches, rheostats, speed-changing screws on variable-speed transmissions, the regulation of throttles on internal combustion engines, and many other similar purposes.

**VARIETY OF TYPES.** Barber-Colman Control Motors are made in four general types: (1) Two-position, to stop at two positions only; (2) Reversible, to be stopped, restarted in the original direction, or reversed, at any point; (3) Multi-position, same as reversible except with 3, 4, or 5 definite and selectable stopping positions between limits of travel; (4) Microtrol, with motor driven potential dividing rheostat for use in Barber-Colman Micro System, providing automatic rotation to system-equilibrium position without "hunting". All units are available with a built-in speed adjustment having range limits in the proportion of 10 to 1.

*Write for Bulletin "Controls for Industry"*

**BARBER-COLMAN COMPANY**  
 1205 ROCK ST. • ROCKFORD, ILL.



**New Improved**  
**LUSTREBRIGHT**  
**Bright Nickel**  
**Process**

Produces Brilliant, Lustrous Nickel Deposits.  
 Eliminates Color Buffing—Re-Cleaning—Re-Racking.  
 An Ideal Base for Chromium. Excellent Throwing Power.  
 No Special Solutions or Changes in Equipment Required.  
 Easy to Control—Low in Cost—Successful—Practical.

Uniform results obtained on all classes of work in still tanks or mechanical barrels. Excellent for zinc die-castings. Any cold nickel solution of standard formula will with the addition of NEW IMPROVED LUSTREBRIGHT give brilliant, lustrous, adherent deposits. Guarant-

teeed not to harm plating solution. Will not cause plate to peel, become brittle or produce streaky deposits. Illustration shows unbuffed deposits produced before and after addition of NEW IMPROVED LUSTREBRIGHT. Write for complete information.

18" x 36" x 12". Up to 180 baskets of parts are cleaned each hour.

Further information may be obtained by writing to Detrex Corp., Dept. MF, Detroit 27, Mich.

**Electrically Heated Oxidizing Tank**

The D. C. Cooper Co., Dept. MF, 1467 S. Michigan Ave., Chicago 5, Ill., announces the development of a new electrically heated oxidizing tank, which is equipped with thermostat control and thermometer for ac-



curate temperature. It is constructed of heavy gauge steel and has heating elements on two sides and the bottom, for low or high temperature range. Each set of heaters has individual switch with pilot light. Any one set of heaters can be turned on without using the others.

**Protective Oil**

Announcement of a new product for the prevention of rust on ferrous surfaces between operations and while parts are in storage is made by Oakite Products, Inc., Dept. MF, 26 Thames St., New York 6, N. Y.

Known as Oakite Special Protective Oil, it has already found wide use in many plants where temporary or semi-permanent surface protection from rust is desired for parts or work, following such operations as grinding, machining, pickling, tumbling, sand blasting, brazing, etc.

This protective oil imparts a thin, transparent, rust-preventive coating which does not interfere with accurate gauging or stain or discolor ferrous surfaces. Parts to be rust-proofed either may be immersed dry, or because of the water displacing properties of Oakite Special Protective Oil, may be immersed immediately after cleaning and rinsing, while parts are wet, thereby eliminating the necessity for drying surfaces by a special hot rinse, air, sawdust or other methods generally used for drying prior to applying rust-preventive.

In addition, finger prints or similar marks resulting from inspection or handling of machined work in process can be readily removed by adding 5% water to the oil.

A new, free, 16-page booklet describing the many industrial applications of this product is available upon request to Oakite Products, Inc., 26 Thames St., New York 6, N. Y.

**W. C. BRATE COMPANY**

14 MARKET ST.

Est. 1860

ALBANY, NEW YORK

## Business Items



Robert S. Herwig

The Bogue Electric Co., Paterson, N. J., announces the addition of Robert S. Herwig to its staff. Mr. Herwig will head the company's expanded Plating Equipment Department.

Previously Mr. Herwig was supervisor of Chemical Research, Eclipse Pioneer Division, Bendix Aviation Corp., Teterboro, N. J. Prior to his Bendix association he was research engineer for Westvaco Chlorine Products, Inc. He also served eight years with American Platinum Works.

A graduate of Newark College of Engineering and Stevens Institute of Technology, Mr. Herwig has written many interesting technical papers of which his "Black Alumilite Process" is most prominent. His lectures on plating and anodizing have been heard by many members of the American Electroplaters' Society of which he is a member. He is also a member of The Electrochemical Society.

A number of sales territorial changes and appointments have been announced by L. L. Andrus, vice-president in charge of sales of American Foundry Equipment Co., 555 South Bykit St., Mishawaka, Ind.

Davis G. Taylor has been named sales representative for a newly created territory covering the San Francisco Bay area with headquarters in San Francisco. For the past two years, Mr. Taylor was associated with sales engineering at the home office.

John Getzen has joined H. G. Mouat, district sales representative in the Birmingham area. Mr. Getzen, a graduate mechanical and electrical engineer from Georgia Tech, spent seven years in the United States Army, finishing his service with the rank of Colonel.

Troy T. Alverson will be sales representative in the newly created Baltimore sales office. His industrial experience includes such positions as general superintendent of the Crane Company's Chattanooga Plant, general manager of Maryland Sanitary Mfg. Co., manager of a Navy Shell Plant, and

The Spotlight of the Entire

Plating Industry is on . . .

# MICCROTEX

## THE New AIR-DRY RACK COATING

### Check these features:



- MICCROTEX is a superior thermoplastic insulating material developed by experienced platers.
- MICCROTEX meets the requirements of all plating, anodizing, tannerizing, parkerizing and bonderizing cycles.
- MICCROTEX may be dipped, brushed or sprayed with equal effect.
- MICCROTEX is a black material with a high luster—highly resistant to plating solutions, acids and alkaline cleaners at boiling temperatures.
- MICCROTEX is tough, resilient, and flexible—attains maximum adhesion without shrinkage.
- MICCROTEX effectively minimizes dragout—is easy to use—saves time and material in application.

MICCROTEX is the answer to the plating industry's greatest need—an air-dry rack insulation that overcomes the difficulties commonly found in applying lacquers. The full story of this remarkable new coating is contained in a special bulletin—write for your copy today!



Developed and Manufactured by Experienced Platers

## MICHIGAN CHROME and CHEMICAL COMPANY

6340 East Jefferson Avenue

Detroit 7, Michigan

assistant to the factory superintendent of the Glenn L. Martin Co. in Baltimore.

David E. Neustadt is the new district representative for the Los Angeles area. He comes to the company from the Egy Register Co., where he held the position of Philadelphia branch manager.

John Nixon will have charge of the American Foundry Equipment Company Sales Office in Atlanta, Georgia. He has recently been separated from the U. S. Navy where he served as a Lieutenant Commander, skippering a division of mine sweepers. Mr. Nixon received his degree in civil engineering from Georgia Tech.

L. C. Kroes has been appointed manager of the Central Regional sales office according to an announcement made by A. O. Thalacker, vice-president and general manager of Detrex Corp., Detroit, Mich., manufacturers of solvent degreasing equipment



L. C. Kroes

# STOP! STOP-OFF TROUBLES

## For Every Selective Plating Requirement



BUNATOL No. 608 Stop-Off (at a new low price) is the last word in a high grade Stop-off for use in any strong alkaline plating solution such as Copper or Tin; it really holds on the trimmed edge.

No. 608 is a quick air drying heavy bodied liquid applied by dipping or brushing. It combines remarkable chemical resistance with adhesive qualities so superior that edges can be trimmed to

a hair-line; and hold without tree or plate through; will not etch polished surfaces; will lay over irregular surfaces without bridging.

For selective hard Chrome plating where defined areas must be protected from the deposited metal use the dependable BUNATOL No. 474 Red Stop-Off. For those extreme service conditions No. 608 is indicated for hard Chrome as well as in alkali.

Let BUNATOL 608 or 474 Stop-Off stop your stop-off troubles. Write for complete information or order a trial gallon at once.

**NELSON J. QUINN COMPANY, TOLEDO 7, OHIO**

# BUNATOL

and chemicals, metal parts washers, Triad cleaners and drycleaning equipment.

Mr. Kroes has been with Detrex Corporation since 1937 serving as a representative in the eastern region for three years when he returned to manage the Michigan Division in 1942.

He is a graduate of the University of Michigan and is a member of the *American Electroplaters' Society*. His headquarters will be in Detroit.

Dr. J. Mitchel Fain, lately Colonel with the Army Air Forces, has rejoined the staff of Foster D. Snell, Inc., Consulting Chemists and Engineers, 305 Washington Street, Brooklyn 1, New York, as account executive in charge of technical development for a group of manufacturers of chemical specialties. For the past four years Col. Fain has been on a military leave of absence.

As Chemical Officer of the North Air Force he served in India, Egypt, Libya,

Tripoli and Tunisia. Battle stars were awarded him for participation in the Egypt-Libya and Tripoli-Tunisia campaigns. Lt. General Brereton commended Col. Fain for his efforts in planning and preparation of operations in support of the invasion of Sicily and the attack on the Ploesti Oil Refineries. When he returned to the United States he became Chemical Officer of the Western Flying Training Command for which service he was highly commended.

Harley E. Huddle has been appointed secretary and sales manager of the *Howard Engineering and Manufacturing Co.*, manufacturers of cleaning and finishing machinery for the metal and food processing industries. Mr. Huddle has been associated with the company for the past seven years, serving as chief engineer prior to assuming his present duties. Mr. Howard, president of the company, stated that the appointment of Mr. Huddle is part of an expansion policy required by increasing demands



Harley E. Huddle

throughout the U. S. and Canada for the company's line of equipment. A specialist in the field of metal cleaning and finishing machine design, Mr. Huddle attended the University of Kentucky where he received his degree in Mechanical Engineering.

E. Reed Burns Mfg. Corp., with offices at 40 Withers St., Brooklyn, New York, announce the appointment of *Reisman Tool & Supply Co.*, of Philadelphia, as their Eastern Pennsylvania representative.

Mr. Lawrence A. Reisman, before the war, represented the Burns Company in the Pittsburgh district. He has a thorough and wide experience in the field of abrasives, and polishing and buffing methods.

The Reisman Company have offices at 44 North Fourth St., Philadelphia. They will cover the state as far west as York, Pa., and east to Trenton, N. J.

T. E. Moffitt has been named sales manager of the *Pennsylvania Salt Mfg. Co.* of Washington, a subsidiary of the *Pennsalt Company* which has its headquarters here in Philadelphia, Pa.

Fred C. Shaneman, president of the Pennsylvania Salt Manufacturing Company of Washington, and vice-president of the parent company, said Mr. Moffitt will be in charge of all heavy chemical sales activities, in the Tacoma, Wash., and Portland, Ore., plants. His headquarters will be at Tacoma.

Mr. Moffitt, a graduate of the Hill School, Pottstown, Pa., and Cornell University, where he majored in chemistry, moved to Seattle, Wash., in 1923 after serving in Naval aviation during the first World War.

Before joining Pennsalt, Mr. Moffitt was Western sales manager for the *Hoover Electrochemical Co.*, at Tacoma, and was recently engaged in special sales development for the *Weyerhaeuser Timber Co.*, at Longview, Wash.

W. D. MacDermid Co., Bristol, Conn., has announced the addition of Mr. Emile J. Beloin to their staff as plant chemist and service engineer. Mr. Beloin graduated from the University of Connecticut in 1939 with a B. S. degree. He also took special

courses at Yale University in chemistry and metal finishing. He was employed at the *Waterbury Buckle Co.*, Waterbury, Conn., as control chemist from 1940 to 1944. Since 1944 to date he has been control chemist and plating supervisor at the *Union Hardware Co.*, Torrington, Conn. Newly completed laboratory and testing facilities have been erected at the company's plant, for service and analytical work in connection with the company's products and also for control work in the field. Mr. Beloin assumed his new duties April 1st.

*Evans S. Schmeling*, well known to the metal cleaning and industrial finishing industry in the Chicago area, now headquarters at the Wyandotte office of *Wyandotte Chemicals Corp.*, where he is assistant manager of their Industrial Department.

April of this year was Mr. Schmeling's seventh anniversary as a Wyandotte Industrial Department representative. After receiving both his bachelor's and master's degrees at the University of Michigan, he



Evans S. Schmeling

spent three years in Greenland on a geological expedition, and then joined the executive staff of a Cuban mining company.

Mr. Schmeling brings to the Wyandotte office a practical and comprehensive knowledge of metal cleaning and finishing procedures. He is at present engaged in the introduction of the new Wyandotte Buffing Compounds and Wyandotte Burnishing Powders. The Industrial Department of Wyandotte Chemicals is headed by *Dr. Roy E. Heath*.

*Clarence A. Norris* has been appointed Chief Chemist of the *Eaton Manufacturing Company's Stamping Division*, at Cleveland, Ohio. Norris will be in charge of the Plating Department, in which bright nickel and chromium plating, and general rust-proofing operations are performed on a wide range of automotive parts.

Before joining the Eaton organization, Norris was connected with the *United States Rubber Company's Development Laboratory*, in Detroit, where he was in charge of metal-to-metal adhesion by a process



## That's why *uses Luster-on* in its 1946 Radio Line!

The words quoted above are not ours. They are facts stated by a Luster-on\* user! They sum up the reasons why the Sales and Engineering Departments at General Electric chose Luster-on\* as the protective bright dip for chassis, speaker shells, and other zinc-plated radio parts — why Luster-on\* looks like *good business* to G-E!

Send a sample of your zinc-plated production parts for free Luster-on\* treatment. It can mean *good business* for you, too.



THE CHEMICAL CORPORATION  
54 Waltham Ave., Springfield 9, Mass.  
Please send me full particulars about Luster-on\* bright dip for zinc surfaces. I am (am not) sending sample part for free dip. No obligation, of course.

Name.....

Address.....

Metal Finishing, May



Another example of the versatility of Abbott Burnishing Materials . . . Notice how the slugs get into those difficult spots . . . the combination of balls, pins, cones, and slugs assures proper preparation of base metals for plating . . . the many shapes of Abbott Burnishing Materials make "contact" certain.

Send for sample kit. Many sizes, many shapes. See for yourself.

**THE ABBOTT BALL COMPANY** 1046 NEW BRITAIN AVE.  
HARTFORD 10, CONN.

# 4 BIG REASONS WHY *Penkote* RACK COATING

WILL

*Save You Money  
ON ALL PLATING JOBS*



valuable production time and reducing rack inventory.

**3. Pen-Kote is more durable—won't crack or harden with long-continued use—has greater toughness, adhesion and flexibility. Thus recoating is cut to the minimum.**

**4. Because of its extreme chemical resistance and smooth surface (without webs or pockets), the Pen-Kote coating permits work to be carried through any combination of plating, cleaning and pickling baths without loss of time for reracking.**

*As a step toward greater production, economy, write today for full information and name of supplier near you.*



**PENINSULAR CHEMICAL PRODUCTS CO.**

**6795 EAST NINE MILE ROAD**

**VAN DYKE • MICHIGAN**

of brass plating. He has had a broad experience in the metals finishing field.

Concurrently, Eaton announces plans to approximately triple the Stamping Division's capacity for nickel and chromium plating.

*E. C. Bullard*, vice-president and general manager of the *Bullard Company* for the past 15 years, has been elected president of the machine tool firm, succeeding to the position held for nearly 40 years by *E. P. Bullard*, whose father founded the firm.

The retiring president, a pioneer in the machine tool industry and one of the early leaders in industrial education in this nation, has been elected chairman of the board of directors.

All directors of the concern were re-elected at the annual meeting, with *George L. Todd*, comptroller, elevated to a vice-presidency, and *E. P. Bullard, III*, vice-president in charge of manufacturing, being appointed assistant general manager.

*E. C. Bullard* is a member of the third

generation of the Bullard family and the third to become president of the machine tool plant founded by his grandfather in 1880. An engineer and businessman who was graduated from the Sheffield Scientific School of Yale University, he served the full apprenticeship in the shop required of all members of the Bullard family.

That apprenticeship was started immediately upon his graduation from Yale, but was interrupted when he enlisted in the Army at the start of World War I and was assigned to the Ordnance Department.

He returned to work in the foundry, the machine shop, the erecting division and almost every department of the Bullard Company, until 1930, when he was named production manager and elected to the board of directors.

In April of 1931, he was elected vice-president and general manager, a position he continued to hold when the plant went through its greatest period of expansion during the second World War. As operat-

ing head of the plant, he directed and coordinated the manufacture of many products strange to the machine tool field. The plant turned out aircraft torpedoes, bomb noses, differential carriers for Army trucks, turbines for the Navy, machined gunsights, fabricated and erected rubber mixing machines.

At the same period, the output of Bullard machines rocketed over 1400 percent over normal.

The new president has also been responsible for many progressive steps taken in its relations with its employees. The newest of these steps was the installation of a retirement income plan, which he personally drafted and executed.

*Mr. Bullard* served as treasurer of the National Machine Tool Builders Association in 1941. He is a member of the American Society of Mechanical Engineers.

*Mr. E. P. Bullard*, the retiring president, began his own apprenticeship under his father, the firm's founder, back in 1892 and has seen the Bullard plant grow from 55 men to a wartime peak of 6,500 employees. He was named general manager of the plant in early 1902 and became president in 1907 following the death of his father.

*Mr. Bullard* holds more than 60 patents and has twice been given national honors for his part in the development and perfection of machine tools. In 1920 the Howard N. Potts gold medal was awarded to him by the Franklin Institute of Pennsylvania for his development of the Bullard Multi-Automatic and in 1927 the A. S. M. E. presented its medal to him for his "outstanding leadership in the development of station type machine tools."

He served as president of the National Machine Tool Builders Association and won wide recognition for his work in establishing apprenticeship standards. He pioneered in establishing the trade school system in Connecticut and the trade school in Bridgeport, for which he raised the original funds and equipment, was re-named in honor of him in 1944.

## Manufacturers' Literature

*Publications listed in this department are obtainable from the manufacturer without charge.*

### Abrasives

*The Clover Manufacturing Co.*, Dept. MF, Norwalk, Conn., has issued its post-war catalog, listing a complete line of coated abrasive materials, including several war-born special applications. A sizeable section of the 47 page booklet is devoted to background technical information on the manufacture, selection, and use of abrasives.

Another publication of the *Clover Co.*, Bulletin No. 4, "Belt Sanding of Metal, The Polishing Lathe" by *E. B. Gallagher*, M. E., describes modern polishing machinery and methods.

### Rust Preventives

A series of rust preventives with a wide range of physical properties is described in the *Tenth Anniversary Catalog* of the Nax-Rust Chemical Corp., Dept. MF, 2423-63 South Halstead St., Chicago 8, Ill. The protective chemicals listed vary from very thin transparent dry coatings to heavy plastic strip-coatings.

Also listed are rust removers and metal cleaners.

### Motor Generators

Motor generators and control panels for a wide variety of electrolytic processes are treated in *Bulletin 202*, a recent publication of the *Electric Products Co.*, Dept. MF, 1737 Clarkstone Rd., Cleveland 12, Ohio.

These motor generators are described as furnishing high efficiency service through individual engineering for each application. Among the processes for which these generators have been specially designed are anodizing, electrocoloring, electroplating, electrotyping, and electrocleaning.

### Zinc Fluoborate Solution

Zinc plating from the fluoborate bath is the subject of *Technical Information Manual ZF-1*, published by the *General Chemical Co.*, Dept. MF, 40 Rector St., New York 6, N. Y. Among the advantages claimed for zinc fluoborate are simplicity of preparation, ease of control and high conductivity.

Bath make-up and control for plating operations using the zinc fluoborate solution are explained in detail.

## Associations and Societies

### American Electroplaters' Society

Pittsburgh's William Penn Hotel will be the scene of the *American Electroplaters' Society*'s first full-scale post war Conference, to be held June 17-20. At this national convention the Society will survey wartime technical advances in electroplating and their potential applications to peace-time production problems. In five educational sessions authorities in various electroplating fields, including two British scientists, will deliver thirty-two papers on the research, production, and economic aspects of the industry. National officers of the Society will be elected for the following year and several outstanding industrial plants of the thriving Pittsburgh area will be open to inspection by the convention-goers.

Society officers anticipate a record attendance since last year's conference in Pittsburgh was, by reason of travel regulations, restricted to a one-day meeting of delegates. Most members will be attending their first convention in two years and interest is reaching a new high as evidenced by applications for hotel reservations.

This Society's unofficial hospitality arm, the *International Fellowship Club*, will play host at Monday night's Open House in the William Penn ballroom. This reception is

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### UNICHROME RACK COATINGS

No matter how tough the plating cycle, Unichrome air-dry and force-dry rack coatings stand up and deliver long, satisfactory service. You can specify either with complete assurance of durable rack protection and minimum recoating costs.

Coating 203 is air dried at room temperature. Where the convenience of air drying is preferred, this coating is recommended for all plating cycles .. including chromium, nickel, and cyanide baths.

Coating 202 is especially recommended where force drying facilities are available. It has the same outstanding chemical resistance as Coating 203, with force drying increasing its adhesion and toughness.

Both coatings are the result of years of intensive research in the field of synthetic resins. Chemically resistant to all plating cycles, they also have the mechanical strength to withstand repeated flexing and shop handling. They are easy to apply too—by simply dipping. Write today for prices and data. Make United Chromium your protective coating headquarters.

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COATING 202 FOR FORCE DRYING

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designed for the making of new acquaintances and re-establishment of old ones. Also on the four-day meeting schedule are the Job Platers Dinner, a full program of ladies' activities, and a projected golf tournament. Non-members of the Society are cordially invited to all sessions except the annual business meeting.

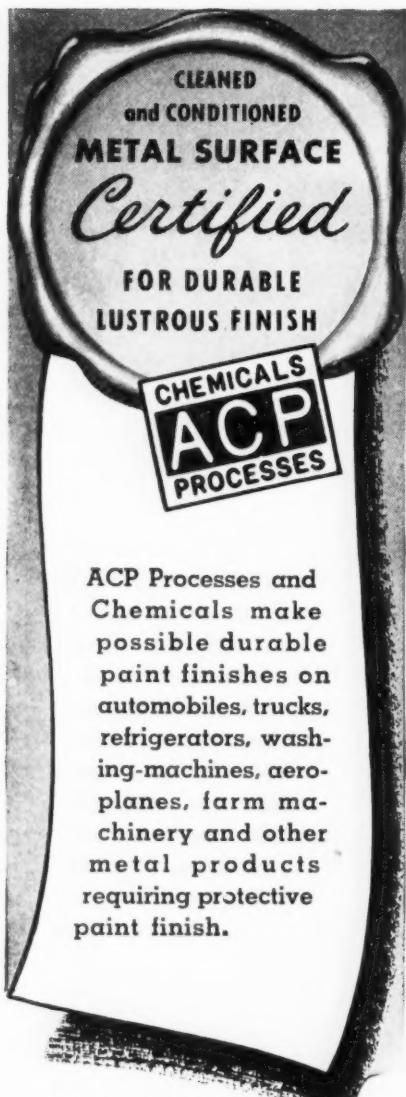
If your interests lie in the electroplating field the 33rd annual Conference of the American Electroplaters' Society in Pittsburgh deserves top booking for the month of June. The dates are from the 17th to the 20th and Mr. J. L. Bray, 230 Beverly Rd., Pittsburgh 16, Pa., handles hotel reservations.

1st at the Covered Wagon in Minneapolis. There were thirty-nine persons present.

Mr. Gordon W. Lilliecrop, Branch vice-president, in the absence of president Paul W. Felt, called the meeting to order at 8:15 p.m. with the introduction of guests. Robert Buckley, Branch secretary-treasurer, gave his report which was approved. The treasurer's report showed a bank balance of \$431.44. A letter from the Milwaukee Branch regarding their annual Educational Meeting was read as well as a letter from the Pittsburgh Convention Committee regarding the attendance at the coming convention. Mr. E. H. Lindemann, Research Fund chairman, read a proposal for each member to donate one dollar annually for the Research Fund. He announced that action would be taken at the May meeting. Mr. Gunar Deedon, Exhibit chairman, announced that his committee are following their job closely. In the

### Twin City Branch

The Twin City Branch of the American Electroplaters' Society met Monday, April



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Use it with any kind of wheel—soft, medium or hard—and the results will speak more eloquently than anything we could say.

Tell us about your toughest job, and we'll be glad to send the "4-A" product that will solve your problem. No obligation, of course.

Instead of glue, use "4-A" Cement and Thinner. Instead of sandpaper, use Polishing Wheels, Belts, Buffs, Rolls, etc. Samples of Compound or Cement sent on request.

HARRISON & COMPANY HAVERHILL, MASS.

**E**ACH of the following American Chemical Paint Co. products excels in the special application for which it was developed—all prepare metal surfaces for durable finishes:

**COLD SPRAY - GRANODINE** produces a dense smooth zinc phosphate coating that protects steel and paint for a durable, lustrous paint finish.

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**DURIDINE 210 B** (formerly 210 B Deoxidine) assures proper cleaning and a thin, tight and relatively hard phosphate coating so essential to a bright enduring paint finish.

**DEOXIDINES** — Phosphoric acid metal cleaners. Remove rust and rusters and prepare metal surfaces properly for lasting paint finish.

**LITHOFORM** — a phosphate coating that bonds paint to galvanized, zinc or cadmium coated surfaces.

absence of *Mr. E. R. Frost*, Party Entertainment chairman, Mr. Lillicrop announced the coming party to be held June 5th and advised that tickets would be on sale at the May meeting. *Mr. A. N. McNeil*, Nomination Committee chairman, announced their nominations for officers for election at the May meeting. They were: *G. W. Lillicrop*, President; *A. T. Leonard*, First Vice-President; *Paul A. Craig*, Second Vice-President, and *Robert L. Buckley*, Secretary-Treasurer.

The door prize for the evening was a leather billfold donated by the *Udylite Corporation* and was won by *Mr. Paul A. Craig*.

Following the business meeting and a short intermission, *Mr. Ralph Pettit* of *Aluminum Company of America* gave a very interesting paper on "Finishes for Aluminum and Its Alloys." Slides and movies were shown in connection with *Mr. Pettit's* paper. The meeting was closed at eleven-fifteen p.m.

*Robert L. Buckley*,  
Secretary-Treasurer

#### Los Angeles Branch

*D. N. Eldred* of the Pacific Division, *DuPont Co.*, El Monte, Calif., was elected president of Los Angeles Branch, *American Electroplaters' Society*, at the March 8 meeting in the Cabrillo Hotel, succeeding *E. W. Wells* of the Los Angeles L'Homme-dieu staff.

The other new officers are: First vice-president, *Howard Woodward*, *Sundmark Supply Co.*; second vice-president, *Frank Bunker*, *L. H. Butcher Co.*; secretary-treasurer, *Emmette R. Holman*, chief chemist of *Turco Products, Inc.*, who served two terms as branch president in 1942 and 1943; librarian, *Gilbert J. Extale*, *General Electric Co.*, Ontario, Calif.

The 1946 board of managers is composed of *Mr. Wells*, *Don M. Bedwell*, *Hallenscheid-MacDonald Co.*; and *Earl Coffin*, *Palace Plating Co.*

*John Merigold* (retired); *Marcus Rynkofs*, *Liberty Plating Co.*; and *Mr. Eldred* were named delegates to the Pittsburgh convention.

The following guests were introduced: *Freeman Taylor*, *Modern Plating Co.*; *R. W. Shill* and *F. Boyd Stilling*, *Harbor Plating Co.*; *H. H. Coyle*, *Liberty Plating Co.*; and *Harry L. DeBar*, *Chemical Engineer*.

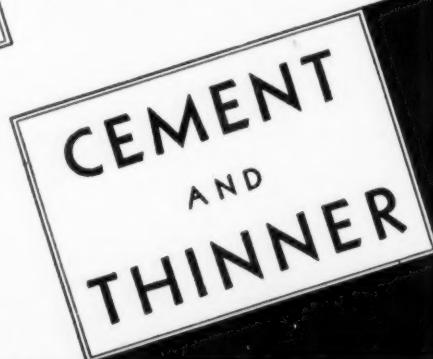
The subject of branch contribution to the *Supreme Society* research fund precipitated considerable comment. *Mr. Eldred* lauded the *AES* research program as outstanding and ". . . the most meritorious thing the *AES* is doing." He favored raising the branch's dues \$1.00 per year and using the proceeds to contribute a definite sum to the national research fund. Various members spoke in favor of making a contribution but opposed raising the dues. In the voting, it was decided to contribute \$100 from general funds without raising dues.

Favorably received was a suggestion by *Marcus Rynkofs* that a silk or satin Los Angeles Branch *AES* pennant be purchased for display at local meetings and at the national conventions. *John Merigold*, *Don M. Bedwell* and *Roy Lostutter* were appointed a committee to acquire one.

Applications for membership were received from the following: *George H. Kuehn*, *Rheem Research Products*; *George D. Fil-*

#### If It's Stainless Steel Polishing It's a "4-A" Job

It's been proved every day in every kind of metal working plant: "4-A" Polishing Compounds are faster, more efficient and more economical for cutting down, polishing and mirror finishing all kinds of steel, including stainless and radium.



Use it with any kind of wheel—soft, medium or hard—and the results will speak more eloquently than anything we could say.

Tell us about your toughest job, and we'll be glad to send the "4-A" product that will solve your problem. No obligation, of course.

Instead of glue, use "4-A" Cement and Thinner. Instead of sandpaper, use Polishing Wheels, Belts, Buffs, Rolls, etc. Samples of Compound or Cement sent on request.

HARRISON & COMPANY HAVERHILL, MASS.

Metallic Arts, Inc., Robert W. Shill and F. Boyd Stilling, Harbor Plating Co.; Oscar G. Smidell, formerly of Chicago branch; T. D. Millhorn, Mefford Chemical Co., and Harry H. Coyle, Liberty Plating Co. The application of William J. Wood for transfer of membership from Lancaster, Pa., branch to Los Angeles branch was accepted.

R. J. Wooley of United Chromium, Inc., presented a talk on Unichrome Copper at the educational session of the meeting.

Mr. Wooley prefaced his remarks with a brief history of copper deposition, stating that copper was one of the first metals to be electroplated. He pointed out that the first application of copper was made more than 100 years ago by means of acid solution, which method was subsequently followed by the use of copper cyanide.

#### *Educational Session and Banquet*

The annual educational session and banquet of Los Angeles Branch, AES, held March 23 in the Los Angeles Breakfast Club, drew an attendance of 100 at each of the two business sessions and 275 at the annual banquet in the evening.

The gratifying attendance at the branch's first postwar convention was due in a large measure to an exceptionally fine program of technical speakers, headed by Walter L. Pinner of Detroit, president of the Supreme Society.

Mr. Pinner appeared at both the morning and afternoon business sessions. At 11:15 a.m. he presented a report on the progress and accomplishments of the Society, bringing local members up-to-date on what the national organization is doing and has scheduled in the fields of technical research, membership increase and general activity. Annual dues, he declared, will probably be increased from \$6.00 to \$10.00 to provide funds for financing the broadened research program.

At 2:30 p.m. Mr. Pinner spoke in his capacity as general technical manager of the Houdaille-Hershey Corp., Detroit, and discussed high speed nickel plating.

The other speaker at the morning session was R. O. Hull of the Hull Co., Cleveland. Delivering the first talk at 10 a.m., he spoke on "Electroplating Past, Present and Future."

Ernest H. Lyons of the Meeker Co., Chicago; Charles Eckhart of the Eckhart Co., Los Angeles; and William Jackson of the Udylite Corp., also appeared on the afternoon program. They spoke, respectively, on "Corrosion and Salt Spray Test on Single and Composite Electrodeposits on Steel;" "A Discourse on the Manufacture of Phonograph Records;" and "Barrel Plating Equipment and Shop Layout."

A question forum, directed by Librarian John Beall of the Harshaw Chemical Co., was held as the closing activity on the afternoon program between 3:30 and 4:00 p.m.

At this convention, Los Angeles Branch for the first time in three years resumed its practice of presenting a comprehensive display of plated articles and shop equipment. The plated items were used as door prizes at the banquet in the evening.

The committee which arranged the educational session and banquet consisted of the following: M. D. Rynkofs, chairman,



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Ernest Lamoureux, Frank Bunker, Allie Sulzinger, John Beall, E. W. Wells, D. N. Eldred, Earl Coffin, Howard Woodward, E. R. Holman and Joseph Sunderhaus.

Electrochemical Society



Wm. C. Moore

At the Congress of the Electrochemical Society held at Birmingham, Alabama (April 11 to 13), the following new officers were elected:

President—*Wm. C. Moore*, New York

Vice President—*A. L. Ferguson*, University of Illinois

Treasurer—*W. W. Winship*, New York

Secretary—*Colin G. Fink*, Columbia University, N. Y.

Dr. Moore is well known to members of his profession. He was born in Nashville, Tenn., where he attended the University of Nashville. He carried out graduate research at the University of Chicago and received his Doctor of Philosophy degree in 1910. In 1920 Dr. Moore joined the research staff of the *U. S. Industrial Alcohol Co.* and recently celebrated his silver anniversary with the company. Since January 1943 Dr. Moore has been a "dollar a year" consultant to the War Production Board and its successor agency, the Civilian Production Administration. At present he is still spending two days per week in Washington helping to liquidate the affairs of the former Office of Production Research and Development.

#### British Engineers' Association

The *British Engineers' Association*, incorporated by license of the Board of Trade in 1912, is the national association of engineering manufacturers in the United Kingdom.

The services for subscribers to the BEA-REGISTER have commenced again after an interval during the years of the war.

Enrollment on the BEA-REGISTER affords to the many friends of the British engineering industry the opportunity of keeping in contact with progressive British commercial engineering practice.

Full particulars of membership are available on application to the British Engineering Association, 32 Victoria St., London, S.W.1.

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- We specialize in plating racks of our own patent.
- Constructed without screws, rivets, solder, brazing, welding.
- We design racks to suit your individual problem.

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## American Society for Testing Materials

The American Society for Testing Materials which for a number of years had its headquarters at 260 S. Broad St., Philadelphia 2, Pa., is now located in its permanent headquarters building at 1916 Race St., Philadelphia 3, Pa. This building, which was purchased and remodeled through contributions made by many of the companies and individuals active in the Society's work, will provide much needed additional space that is required by the expansion of the Society's staff. The technical work in which A.S.T.M. since 1898 has concentrated its activities, namely, the development of standard specifications and tests for materials and the promotion of knowledge of properties of materials through research, has necessitated a considerable expansion of the headquarters group.

For a number of years many of the A.S.T.M. leaders have hoped that there would be an opportunity to obtain a permanent headquarters building, and this now has been achieved.

The new building is strategically located on Philadelphia's Parkway, adjacent to the Academy of Natural Sciences and close to the Franklin Institute and the main Philadelphia Free Library.

While the alterations to the building will not be fully completed until early summer, sufficient progress has been made so that the staff can vacate its old quarters and the present building owner can use this needed space.

### News from California

By FRED A. HERR

Service Plating Works, 821 Randolph Street, Los Angeles, has installed new 6x2x2 bright nickel and bright copper tanks for handling a complete line of small plumbing parts and miscellaneous large and small bathroom fixtures. J. B. Haymer of this firm reported that other equipment recently installed included two 40-gallon burnishing barrels, a 30-gallon nickel barrel and a 120-gallon tank.

Oscar Smidell announces that his present trip to Southern California is "... final and permanent."

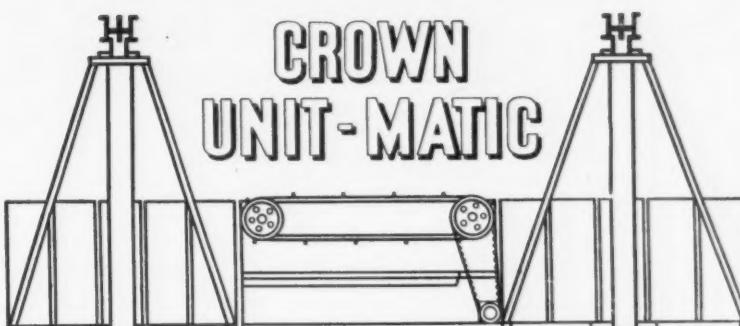
To the plating industry in general throughout the country Mr. Smidell needs no introduction. He has been a well-known figure in the industry for more than 3½ decades. He was a charter member of Chicago Branch, AES.

General Tire & Rubber Co. has augmented the equipment in its Pasadena, Calif., plating department by the installation of a high-speed copper tank, a nickel and a chromium tank for use in plating plumbing fixtures and hardware. B. C. Jones is superintendent of plating.

Floyd C. Klein and Millard T. Littrell have filed notice of intention of engaging in business under the firm name of

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FULLY AUTOMATIC  
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Specify Kocour Sets from your supplier.

*National Plating Co.*, at 3201 South Main St., Los Angeles.

*National Iron Works* at San Diego has installed a galvanizing unit, *David Bell*, assistant manager reports. The galvanized metal produced by the company is both for its own use and for sale to the public.

Contract has been awarded for the construction of a \$27,000 addition to the plant of the *U. S. Porcelain Enamel Co.*, 4635 East 52nd St., Los Angeles.

*California Metal Enameling Co.*, Los Angeles, has announced that plans are being prepared for construction of a one-story factory in Maywood, Calif., measuring 180 x 280 feet in area.

#### Reconversion in California

*Poulsen & Narden's* San Diego plant is at present producing a line of aluminum kitchen utensils, including a dutch oven roaster and roaster pan, roaster rack, a cookie sheet and a utility pan. Plans for the immediate future call for production of biscuit and meat loaf pans in both the San Diego and Los Angeles plants.

Indicative of this firm's rapid reconversion from war production, it now requires aluminum at the rate of one million pounds per month for production of postwar items.

*Century Metalcraft Co.*, 6000 Avalon Blvd., Los Angeles, a subsidiary of *National Pressure Cooker Co.*, of Eau Claire, Wisc., is producing pressure cookers and a general line of aluminum kitchen equipment.

*Pierson Electronic Corp.*, 533 East Fifth St., Los Angeles, has begun the production of communication and commercial radio equipment.

*Clayton Mfg. Co.* has announced plans for construction of a new plant with 130,000 square feet floor area Valley Blvd. and Rosemead Ave., Alhambra, for increased production of hydrosteam cleaners, steam generators, float valves and hydraulic engine testing dynamometers.

*Wolf Range Co.* is remodeling its plant at 5731 S. Alameda Ave., Los Angeles, for increased postwar production of heavy duty commercial gas cooking equipment.

#### PREPARATION OF ALUMINUM

(Concluded from page 206)

##### Mixed Acid Dip

3 parts concentrated nitric acid.  
1 part concentrated hydrofluoric acid.  
Room temperature.

#### References

<sup>1</sup> U. S. Pat. 1,256,954 William J. Travers, Buffalo, N. Y.

<sup>2</sup> Harold K. Work, "Electroplating on Aluminum and its Alloys", presented before the Electrochemical Society meeting at Bridgeport, Conn., April 28, 1928. [Trans. Electrochem. Soc. 53, 361 (1928)]

<sup>3</sup> U. S. Pat. 1,627,900 (May 10, 1927), Edward H. Hewitson, Rochester, N. Y.

<sup>4</sup> U. S. Pat. 1,971,761 (August 28, 1934), William J. Travers, Buffalo, N. Y.

<sup>5</sup> U. S. Pat. 2,036,962 (April 7, 1936), Johannes Fischer, Germany.

<sup>6</sup> William L. Travers, "Preparation of Anodized Aluminum for Plating", Technical Sessions American Electroplaters' Society (1942).

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**Zinc Plating—QUALITY** Zinc plating is playing a larger role each day in the plating field—Partly because of the scarcity of metals Zinc is now filling the gap.

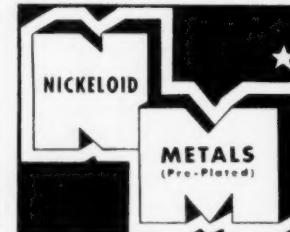
**Promat No. 99 Zinc** produces high quality at low production cost. Using direct current only and making use of basic addition agent C 42, offers a broad operating range for barrel plated or racked work. Allows efficient use of high current densities on racked parts, improved covering power, and increases production capacity of equipment.

**No. 99 Zinc** produces unexcelled quality plating! Characteristics are wide plating range with resultant freedom from burning—uniform color over significant and recessed areas—better protection of basic metal due to better distribution of deposit.

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★ NICKEL • CHROMIUM • BRASS • COPPER ★  
Electro-plated to all common base metals  
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